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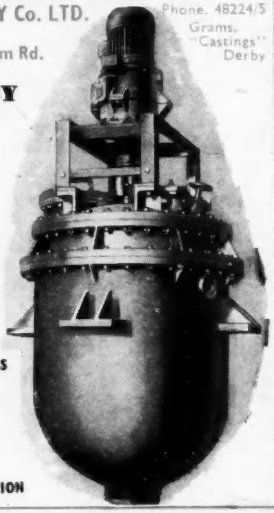

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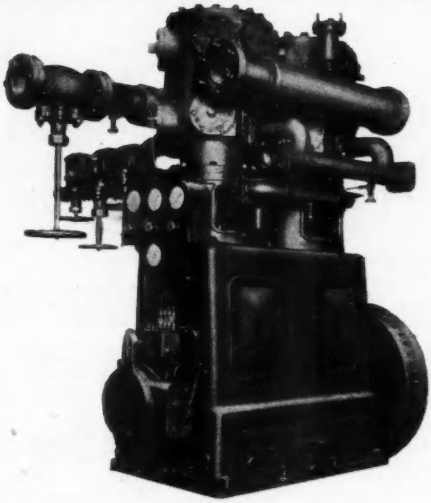

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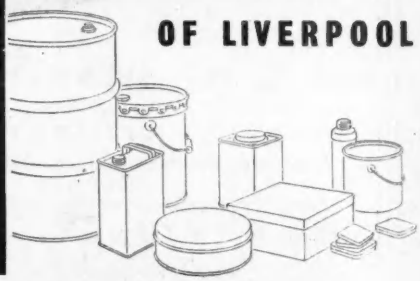

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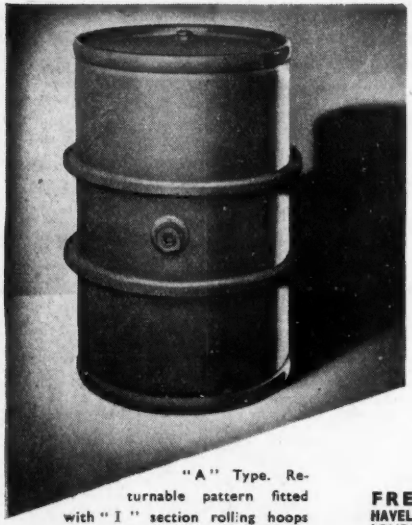

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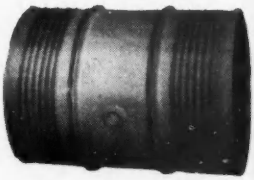

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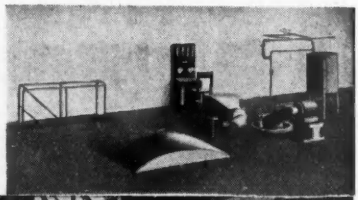

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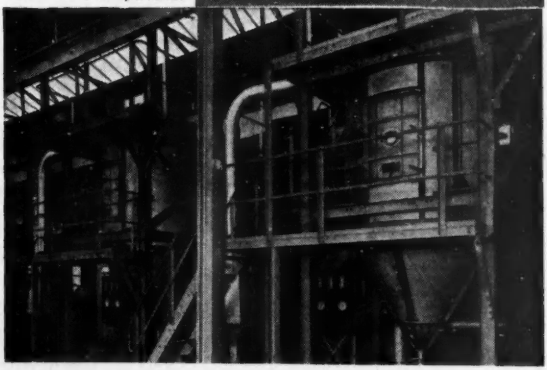

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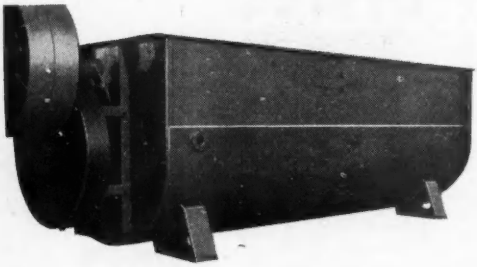

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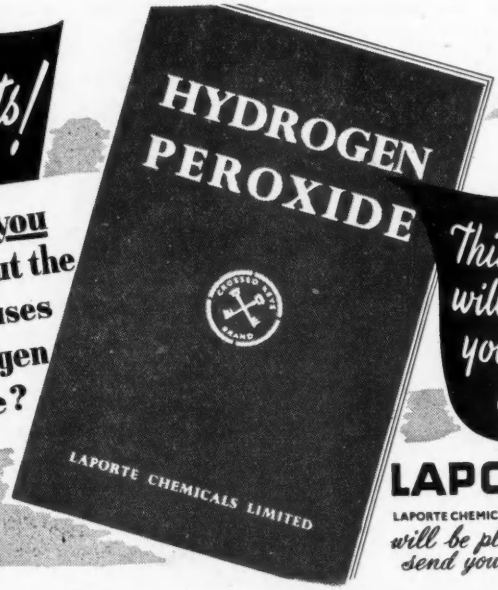

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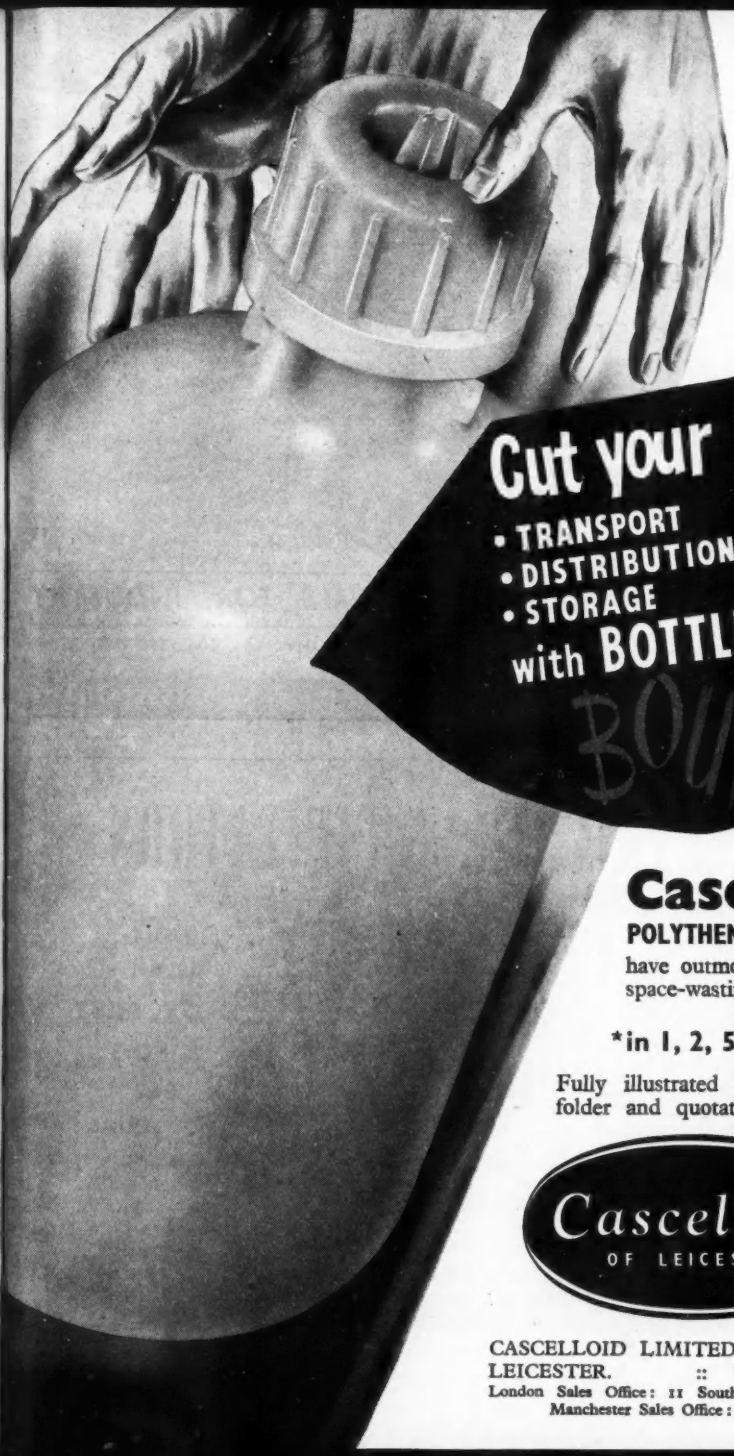

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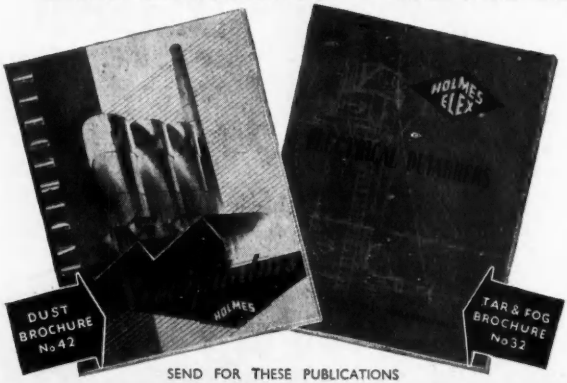

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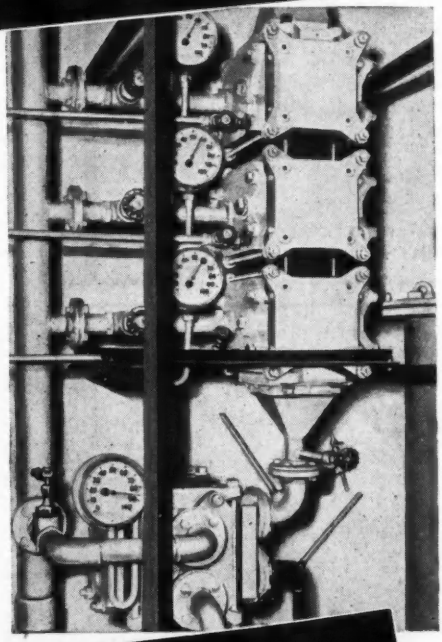

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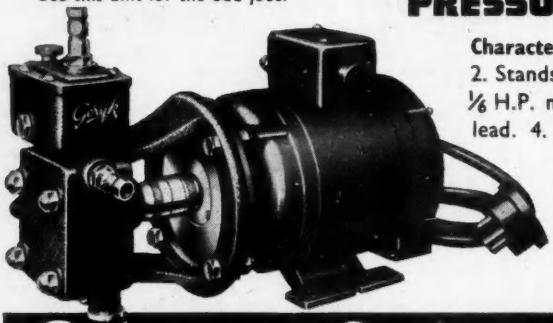

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Volume LXVI **7 June 1952** **Number 1717**

Scientist Scarcity

THE 1951-52 and fifth annual report of the Advisory Council on Scientific Policy (H.M.S.O., Command 8561, 6d.) is a disquieting document. Although considerable efforts have been made since the war to increase the output of qualified chemists 'there is likely to be a long-term shortage of practically all kinds of scientists', especially chemists, chemical engineers, electrical engineers, mechanical engineers and physicists. In the view of the Council this serious shortage is to be expected whether or not the economy of the West faces inflationary or deflationary conditions in the next decade, for the national problems of both climates can only be solved by increases in industrial efficiency; whether the emphasis lies upon more production or upon more economical production the same 'cure' applies—the greater utilisation of scientific workers. 'The implications are unmistakable. Man-power must be used with the greatest efficiency. In the evolution of industry the trend is to increase the value of plant used per man employed. Today this index in the United States is twice what it is in Great Britain.' The necessary changes—an increase in the proportion of high-grade to low-grade staff and greater use of plant per worker—depend directly upon increases in the absolute and relative number of scientists in our industries.

It will be recalled that shorter-term reviews of the supply/demand prospects for scientists were made a few years ago by Technical Committees set up by the Ministry of Labour. Although these earlier studies also predicted shortages of scientists, the estimates of demand were considerably based upon employers' estimates of expansion and on the whole these estimates were cautious and did not allow for the effects of recurring economic crises or for the huge effect of re-armament. The Advisory Council's new report, much wider in scope and outlook, out-dates these earlier findings and in so doing produces bigger problems. If Britain is to survive as a significant power these are problems that must be overcome. Let it not be assumed that this is yet another *motif* from the Anglo-American theme of gloomy comparison. 'It is not only in comparison with the United States that we produce significantly fewer scientists and technologists; a similar disparity exists between this country and Switzerland, whose population and resources . . . are very much smaller than our own.'

In giving advice, it is far easier to isolate a serious problem than to suggest the means of solution. It is to the credit of the Council that this second and more difficult task has been firmly faced. The light of constructive criticism has been directed towards some vital weaknesses in our present educational arrangements.

If many more scientists must be produced, human 'raw material' as well as expanded training facilities must be available. The Council has found 'much evidence' to support the view that large numbers of potentially good university students leave school at the age of 16 and that quite often the quality of those who leave at 16 is better than that of those who stay on. In short, the universities are drawing recruits from only a portion of the best national talent. A second factor of wastage is boldly and firmly presented—the public schools are not producing a satisfactory proportion of potential scientists. 'The interest of the ablest boys is often attracted to the subjects taught by the most outstanding masters, and . . . in public schools this is more likely to operate in favour of subjects other than science.' The so-called humanities still lead in our public schools. "Essentially there is an insufficient appreciation of the contribution that science makes to a liberal education, and lack of awareness of the great opportunities for scientific, and especially engineering, training that are available in universities other than Oxford and Cambridge.' These are potent words in an official report and they should be joined with two other conclusions of the Council—first, that there is a big and urgent need for young men who combine qualities of leadership with a sound knowledge of science, and second, that graduates in 'arts' are being produced by the universities in greater number than before the war and many of them cannot find employment fitted to their attainments.

The Council has examined criticisms of the quality of present-day graduates in science. Its conclusions refute the views of critics. Quality is 'adequate, and, indeed, high.' It is interesting to note that the main dissatisfaction was expressed by the DSIR and the Agricultural Research Council, and the Advisory Council suggests that the views of these state scientific services are biased because the best graduates find employment elsewhere! Here, perhaps, comment might have bitten more deeply and the reason why the best scientists choose industry rather than government as their employer—better pay—might have been stated. While disagreeing that the scientific attainments of today's graduates are below a desirable standard, the Council supports the more general opinion that a broader educational background is needed.

What is probably the most important point of all—and one to which we have frequently drawn attention in these pages—is the supply of teachers of science. At present the intake of new science masters is barely sufficient to replace losses. Here again the Council might have exposed the economic back ground.

This Report virtually calls for a revolution in the country's attitude to scientists and scientific education. If it is not acted upon—and with some sense of urgency—Britain's ability to remain among the greater powers will melt away.

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Notes & Comments

Antiseptics Badly Needed

ADVANCES in hygiene create new and large markets for chemicals. No clearer example of this could be quoted than the rise in the use of antiseptic chemicals in the milk industry. To judge from a paper recently read at the Royal Sanitary Institute Health Congress, no branch of the food-handling industry needs chemical help more than our slaughter-houses. The reader of this paper, Mr. H. E. Bywater, Chief Veterinary Officer of West Ham, exposed conditions that can only be described as deplorable. He quoted a case where water used for wiping down carcasses had a count of 1½ millions of organisms per ml. with *Bacterium Coli* present up to 1 : 1,000 dilution. Such water was as bad as sewage! It was below standards acceptable for swimming-bath water. Mr. Bywater urged the use of quaternary ammonium compounds in water used for wiping and washing down and expressed the view that their residual effects upon meat could not be of more than academic importance. Most people would certainly be only too ready to accept any residual effect possibilities rather than continue to receive meat regularly washed down with bacterially filthy water.

Standards Deplorable

NOR is this the only use for chemicals that should be urgently developed in our abattoirs. Among a wide range of improvements needed, Mr. Bywater urged attention to cleanliness of approaches and surrounds of slaughter-halls, cleanliness of meat loading-bays, and adequate control of rodents and insect pests. In general, the same regard for hygiene that is found in the milk and ice cream industry should be held. Undoubtedly there would be acute public apprehension if the average conditions in British slaughter-houses were better known. Conditions have steadily deteriorated with official centralisation; control of slaughtering since the early part of the war has eliminated the private and careful slaughterer. Today standards have fallen to 'the lowest common denominator' and 'in all cases hygienic standards are subservient to the demands of the "put-through".' We must regard it as a paradox of our age that the same officialdom that puts through new and praiseworthy regulations for milk hygiene seems complacent towards declining standards in the slaughter-houses it directly controls. If further evidence is needed there is Dr. Pyke's statement in his recent book, 'Townsman's Food'—'It is difficult to deny that the proportion of infected meat *may* have increased during the fifth decade of this century.'

A New Journal

THE Ministry of Agriculture deserves the fullest praise for launching a new scientific journal, *Plant Pathology*. The name given to it might suggest that this journal will deal exclusively with biological or botanical subjects but in fact its scope will be very wide, including the discussion of curative and preventative measures as well as studies of plant diseases and their symptoms. This is made clear in the first issue, which among other less chemical papers describes trials of substitutes for sulphuric acid in potato haulm killing, rabbit repellents for fruit trees, and the control of smut in millet seed by chemical treatments. One of the major objectives of the journal is to give prompt information about the incidence and control of plant diseases and pest attacks in Britain and this, too, must be widely welcomed. In the past this very valuable information has too often suffered long-delayed publication, for the annual reports from our excellent research stations emerge six to nine months after the end of the year dealt with, while original papers must inevitably wait their patient turn in a queue before they appear in the existing journals of agricultural science. As is well known, our scientific societies are finding it increasingly difficult to maintain their present volume of journal publications, so there will be no heart-burning over the Ministry of Agriculture's decision to intervene

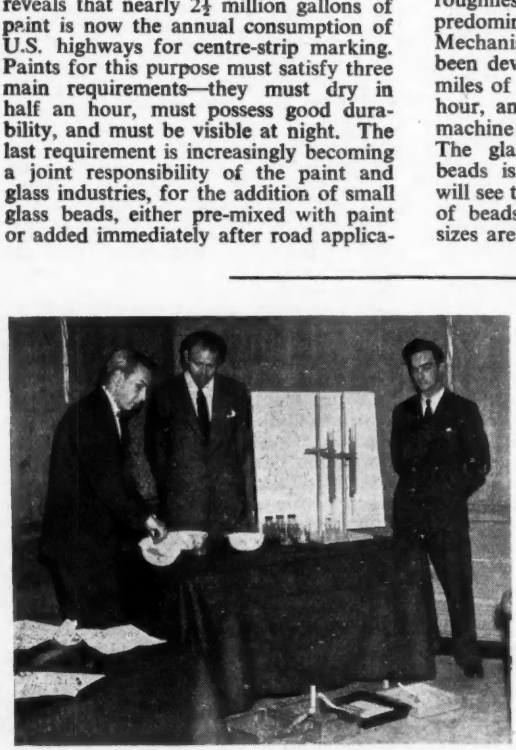
in a field that has expanded in all directions in the past decade. *Plant Pathology* will be issued quarterly and is obtainable from H.M.S.O. at 4s. per copy or 16s. 6d. delivered by post per annum. The scientific editing will be conducted from the Plant Pathology Laboratory at Harpenden (Herts), and the fact that manuscripts may be sent there for consideration suggests that the new journal will not restrict itself to describing research in government centres.

Paint for the Roads

MODERN systems of traffic control have steadily built up a new market for paint; as is to be expected, new uses have brought with them new problems in technology. An interesting summary of American developments (*Chemical Week*, 1952, **70**, 18, 45-46) reveals that nearly 2½ million gallons of paint is now the annual consumption of U.S. highways for centre-strip marking. Paints for this purpose must satisfy three main requirements—they must dry in half an hour, must possess good durability, and must be visible at night. The last requirement is increasingly becoming a joint responsibility of the paint and glass industries, for the addition of small glass beads, either pre-mixed with paint or added immediately after road application, has developed as the best means of ensuring night visibility; it is also said to reduce the wear upon the painted lines.

Four Main Types

FOUR main types of paint are used—lacquers based upon natural resins, oleo resins, alkyds, and butadiene-styrene formulations. The lacquers, owing to their spirit build-up, dry very rapidly, but there is some evidence that their durability is questionable owing to cracking, which releases the glass beads when these are also used. More normal paint types are heavily composed of driers and pigments to facilitate drying; in any case a rough surface finish rather than smoothness is needed as roughness improves night visibility; non-beaded paints are often filled with mica to increase the roughness of surface. Two colours are predominantly used—white or yellow. Mechanised application methods have been developed so that from four to six miles of centre-line can be put down per hour, and in Ohio it is reported that a machine operates at 15 miles per hour. The glass industry's market with the beads is already far from small—1952 will see the addition of six million pounds of beads to U.S. road surfaces. Bead sizes are given as 3-30 mil. spheres.



As reported in THE CHEMICAL AGE of last week (p. 826) it was announced at a Press conference on 26 May that Monsanto Chemicals Ltd., is to manufacture the new soil conditioner, Krilium, in the U.K. Our photograph, taken at the conference, shows Dr. B. T. Mowry, co-discoverer of Krilium, giving a demonstration, assisted by Dr. A. J. Lloyd and Dr. C. Morgan.

Zinc Dust as a Protective Pigment

Methods of Production & Uses Outlined

MR. A. PASS, of Amalgamated Oxides (1939), Ltd., gave an account of the position regarding the use of zinc dust by the paint industry, particularly for protecting ferrous metals from corrosion, before the London Section of OCCA on Wednesday, 7 May.

Zinc pigments, said Mr. Pass, occupied a prominent place in the pigment field for both their decorative and protective properties, but until recent years metallic zinc, in the form of zinc dust, seemed to have been little used in this country, although it was first proposed as a pigment as far back as 1840, some 30 years before the invention of lithopone and, indeed, before zinc oxide was in wide general use by paint makers.

Zinc dust is a blue-grey powder consisting essentially of metallic zinc in a fine state of sub-division, but frequently containing appreciable quantities of zinc oxide, and Mr. Pass discussed briefly the methods of production. The most important method of production of the powder for pigmentary purposes is the volatilisation process, and it was with the material produced by that process that his paper was concerned. Normal practice produced a material with a free metallic content of 95 per cent or more.

The actual metallic particles had a coating of zinc oxide—inevitable with the particular method of manufacture—and a small quantity of free zinc oxide might be present. The general chemical properties conformed to those associated with zinc metal, but, in common with many metallic powders in a fine state of sub-division, zinc dust was easily oxidised by moisture with evolution of hydrogen and a rise in temperature. Under suitable conditions this might lead to combustion; so that proper packing and storage were matters of consequence.

Specific Gravity

The specific gravity of zinc dust was of the order of 7.05. The specific surface was around 0.18-0.23 $m^2/gm.$, which gave an average particle size of 3.7-4.7 microns. The particle size distribution was rather wide and the particles were rather large by modern pigmentary standards, but sufficiently fine for industrial and protective coatings. In shape they were spherical or nodular, and as shown by ordinary microscopical examination were relatively smooth and free from irregularities or crevices.

Oil Absorption Low

On the pigmentary and paint properties the oil absorption of zinc dust was low, normal values being 6-8 per cent. An accurate determination was rather difficult, for although they were easily 'wetted', the particles did not adhere well. The hiding power of a normal zinc dust paint was excellent, one ordinary coat completely obliterating the most 'contrasty' surface. The reducing strength of the pigment was very poor, however, so much so that substitution of a coloured pigment to the extent of only 10 per cent of the total was sufficient to change the colour completely. The explanation for this difference was that the metallic particles being completely opaque, they did not retract light, so that in themselves they had little tinting strength. When light-refracting crystalline pigments were added they tended to dominate the optical properties and so produced a colour effect which seemed out of all proportion to the quantity involved.

With the high specific gravity and pigmentations employed, zinc dust paints were very heavy, the weight per gallon being from 25 lb. On coverage, the ordinary 80/20 zinc dust/zinc oxide paint would give a good coat of 700-750 sq. ft. per gallon.

The adhesion of zinc dust paint was usually excellent, even to galvanised iron surfaces. A possible explanation was that the extremely large and active zinc surface preferentially adsorbed any decomposition products or any disturbing film on the galvanised surface which interfered with or prevented an adequate bond with ordinary paints.

Paints formulated with zinc dust could be completely non-toxic, a fact which, combined with their extreme ease of application, made it possible for suitable formulations to be sprayed. That method of application was used in the U.S.A. for dealing with large sheet iron agricultural structures.

The manufacture of zinc dust paints pre-

sented no difficulty; possibly owing to their coating of zinc oxide the particles were easily wetted and dispersed, and a mixer was usually the only plant involved in making the ordinary high metallic coating. If zinc oxide or other pigments were included, they should be milled in the usual way before addition of the zinc dust.

Electro-Chemical Process

Discussing the use of zinc dust coatings for the protection of iron and steel, he said it was now generally recognised that the corrosion of iron immersed in an electrolyte (say) seawater, was an electro-chemical process. If the iron was given a layer of a less noble metal and electrical contact resulted, protection would be conferred on the steel at the expense of the protecting metal. With clean steel surfaces such contact could be made with paint films richly pigmented with zinc dust, and the films formed continuous electrically conductive systems.

Since the electrical system was continuous, it followed that conductive zinc dust paints would confer protection in areas which for some reason were not covered, such as, for instance, spots damaged by abrasion. Mr. Pass referred to recent work by Crennell which emphasises the importance of this type of protection in seawater, and discussed the implications following from Crennell's conclusions.

That conductive zinc dust paints would protect steel where breaks in the paint film existed, could be demonstrated beyond doubt.

Obviously protection by a zinc coating would be expensive if full continuous electrolytic action took place. Fortunately, even with the most conductive coatings the action eventually deposited, on the steel and in the zinc dust film, basic salts, zinc hydroxide or, from seawater, possibly calcium carbonate, which tended to stifle further reaction, thus weakening the flow of current considerably, and at the same time in themselves conferring valuable mechanical protection. Mr. Pass showed a zinc-rich paint film after immersion in seawater. Although based on plasticised polystyrene, soaking for 24 hours in xylene had failed to soften it, and in effect it had become an inorganic coating of considerable hardness and adhesion.

He said it would seem probable that the protection conferred on steel under atmospheric conditions by the zinc dust and zinc oxide paints arose from a combination of factors, and more investigation would be necessary to resolve the matter.

The paints intended for marine use, said Mr. Pass, could not yet be said to have proved themselves by extensive practical use, as had the zinc-dust/zinc oxide paints used in the U.S.A. for the protection of steel or galvanised iron from atmospheric attack. Reports indicated that they could confer protection on ships' hulls for periods of up to ten years when properly applied, and there had probably been a great deal of practical usage which was not reported.

Mentioning a few miscellaneous zinc dust coatings and uses, he said the conductive properties could be made use of in, for example, the manufacture of electrically conductive stoppers or fillers, and a fairly extensive application was in the production of welding primers. Sheet metal parts might be given a coat of highly pigmented zinc dust primer, which would not only protect the parts during storage, but would also allow electric welding operations to proceed without undue interference. After welding, parts of the completed structure—say a car body—difficult of access for normal painting, would remain protected, as well as the welds themselves, in the same way as scratch marks and other discontinuities.

Compositions formulated as non-drying media could be used with zinc dust for temporary protection of bright steel parts or for the more permanent protection and lubrication of pipe thread joints, etc. They could be used on petroleum products, waxes, wool grease, etc., possibly hardened with some suitable resin, and the addition of an ultra fine particle size zinc oxide was recommended in some cases to provide a high yield value and so allow the composition to 'remain put'. These compounds could also be used for the more permanent protection of pylons and other structures.

Good Corrosion-Resistance

Tests showed, said Mr. Pass, that paints formulated on zinc gave excellent corrosion-resistance to steel against both atmospheric and seawater attack. It was concluded that the chief obstacle to the extensive use of such coatings for marine purposes was the tendency to blister, and although electro-endosmosis might be largely responsible, highly metallic zinc coatings developed alka-

line surfaces on contact with sodium chloride solutions which might produce intercoat blisters if saponifiable following coats were used.

Zinc dust coatings offered certain advantages possessed by few other types used for protective purposes. Those based on zinc dust/zinc oxide mixtures in ordinary reactive media seemed to be the ideal coating for galvanised iron, and on ordinary steel at worst equalled red lead coatings for protective properties, and in addition had the outstanding virtue of being non-toxic and so were available for application by any means with risk to no-one. In view of the widespread use of these coatings abroad, it was surprising indeed that they had not found greater favour here.

The more highly metallic coatings, using special media, already found considerable use in this country, and, if the blistering trouble could be mitigated, might well provide the most effective coating for marine purposes evolved up to now. But, said Mr. Pass, we must keep a sense of proportion and remember that coatings based on other protective pigments also present their problems. From the reports on their use which had appeared, and the demand for the pigment which had developed over recent years, it would seem that, with all their faults, the existing highly metallic coatings, based on polystyrene, chlorinated or isomerised rubber, must be proving very effective.

Marine Protection

I.C.I.'s Brixham Station Visited

THE importance of paints and finishes as a protection against marine organisms, corrosion and other under-water problems was demonstrated recently to some 40 members of the National Paint Federation when they visited Brixham research station of the Paints Division of Imperial Chemical Industries, Ltd.

At Cumber House the party was received by the president of the National Paint Federation, H. W. G. Bidgood, who is joint managing director of I.C.I. Paints Division, and they were then shown round the laboratories by the staff of the Brixham station, led by C. I. Snow, assistant research manager, and had explained to them various aspects of the work carried out.

The life history, growth, and settlement of marine organisms which cause fouling on ships' hulls were illustrated by photographs, diagrams and specimens in the entrance hall and anti-fouling laboratory, while investigations made to prevent such settlement by the production of improved paints was demonstrated in the paint laboratory.

In the analytical laboratory the visitors were introduced to techniques used for the study of the penetration of wood by marine-bearing organisms and methods of estimating the efficiency of protective treatment.

Displayed in the chemical laboratory was the routine of research directed to the production of improved paints for the protection of ships' hulls and other underwater structures from corrosion.

After visiting the biological laboratory the tour was concluded with an inspection of the collection of living marine organisms at the field station in the Freshwater Quarry.

SCI Summer Farm Tour

A FARM tour of East Anglia, to take place from 19-25 July, has been organised jointly by the Agriculture and Food Groups of the Society of Chemical Industry. The tour is open to members and their wives or other close relatives, but numbers must be limited to 60 persons.

A programme centred on Cambridge where the party will be accommodated in St Catherine's College and the Royal Hotel, has been arranged with tours to all parts of East Anglia involving over 500 miles travel by coach.

Visits will include: Elvedon reclamation scheme (Iveagh estates), Newmarket; Sprowston Agricultural Station, Wroxham; Sedgeford grass-drying plant; the Low Temperature Research Station, Cambridge; and Audley End, Saffron Walden, claimed to be the largest glasshouse in England.

Cost of the tour will be £14 14s. a head, which covers everything provided in the programme, including travelling, admission fees and gratuities.

I.C.I. Dismissals

The Imperial Chemical Industries factory at Grangemouth, Stirlingshire, will dismiss 30 men on 6 June. The factory, which manufactures textile dyes and medical drugs has been affected by the Lancashire cotton recession and Australian import cuts.

Fire Damage in 1951

Lessons of Some Major Outbreaks

DIRECT damage caused by fire in 1951 in the United Kingdom and the Republic of Ireland was estimated at £23,148,000, the largest recorded annual loss.

While chemicals were not seriously involved, the causes of some of the major outbreaks and the lessons to be learned from them, as recorded in the April issue of the *F.P.A. Journal* (No. 17) published by the Fire Offices' Committee of the Fire Protection Association, deserve the attention of the industry.

Losses estimated at over £500,000 resulted from a fire on the premises of a bleaching company at Hollingworth at the end of October. The process employed in the bleach croft house, the section of the works mainly concerned, was entirely wet. Cloth was treated with acid solution, bleached and washed, before being passed through apertures in the wall to a finishing room for drying and further processing.

Cause of the outbreak was thought to be the overheating of an electric motor. The ease with which the combustible roof burned and collapsed should be an example because it showed that the type of construction of a building can have an appreciable effect on firespread, even where wet processes are involved.

Some 7,000 gallons of petroleum were involved in a fire which broke out on 7 September, 1951, in a depot of an oil company at Royal Edward Dock, Avonmouth, Bristol. The fire lasted about 38 hours.

About 55,000 gallons of foam compound were used, but production was hampered by the incessant choking of inline inductors by the varying qualities of foam compound, some of which had deteriorated through age. The fire showed clearly that foam equipment has not yet reached a completely satisfactory and reliable standard for employment in really large fires.

Protection of Tanks

The advisability of protecting all tanks with ready means of cooling (that is, with drencher installations) was emphasised and the advantage of other fixed fire extinguishing equipment was also well illustrated.

Other fires summarised included a cellulose nitrate and cellulose acetate store in Liverpool and a wholesale chemist's at Stockton-on-Tees.

In the Liverpool fire cellulose nitrate and cellulose acetate base sheets were stacked in the building on open steel shelves. Near one of the entrances there were a few hessian bags containing off-cuts. There was also a quantity of nickel silver strips stacked on end. The store was kept locked and the last person to enter it was a storeman some nine hours before an explosion and fire were reported by a passer-by.

The stock of cellulose nitrate base material was almost completely destroyed and the cellulose acetate base material severely damaged, all the exposed surfaces of the latter being fused by heat to a depth varying from half an inch to two inches.

Flames and heat affected a wide area, but fortunately there were no other buildings in the vicinity. The radiant heat from the fire was such that a wooden telegraph pole 65 ft. away was ignited.

At the Stockton works a quart-sized bottle of benzene was being carried from the basement to the ground floor when it was accidentally dropped and broken. The benzene vapour was ignited by the flame of a gas-heated radiator.

About two-thirds of each of the ground, first and second storeys and their contents were severely damaged by fire heat smoke and water, and the roof was destroyed.

BOT Considering Renewals

THE Board of Trade are considering the renewal for the period 19 August, 1952, to 19 February, 1953, of the exemptions from Key Industry Duty set out in the Safeguarding of Industries Exemption Orders, and in any further Exemption Orders which may be made before 19 August, 1952, under Section 10 (5) of the Finance Act, 1926, as amended by subsequent enactments. Lists of the articles exempted by these Orders from Key Industry Duty until 18 August, 1952, appeared in the Board of Trade Journal on 23 February and 19 April, 1952, and were also published in Statutory Instruments 1952, Nos. 277 and 766. Any communications arising out of this announcement should be addressed to the Industries and Manufactures Department, Division 1, Board of Trade, Horse Guards Avenue, Whitehall, S.W.1, as soon as possible and in any case not later than 21 June, 1952.

SCI Chemical Engineering Group's Report

Rising Costs and Falling Membership Cause Concern

A SLIGHT anxiety concerning the future was expressed at the 33rd annual general meeting of the Chemical Engineering Group of the Society of Chemical Industry, held in London on 28 May. Membership of the group at 31 December, 1951, was 705, which was a slight decrease, and deliberations of the committee had been largely devoted towards implementation of the Membership Action Report of the Society. Much thought had been expended on the subject and various preliminary moves had been made with the object of increasing membership. Much work still remained to be done.

The continual rise in the costs of printing and publishing had had a hampering effect and the financial outlook was causing some concern.

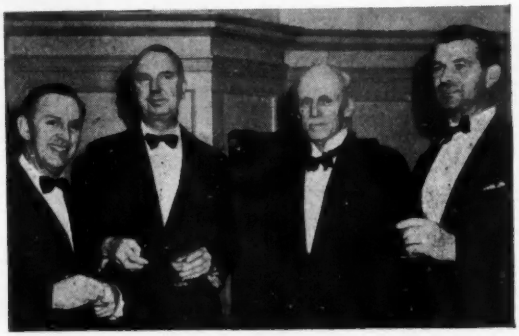
In other respects the committee was able to report a satisfactory year of activity in which the usual full programme of meetings in London and joint meetings with provincial sections and groups had been carried out.

By the death of Mr. C. J. T. Mackie early in 1952, following ill-health as a result of an accident recorded at the previous annual general meeting, the group had suffered a grievous loss. Mr. Mackie had been identified with the group since 1924. During the year, the death of five other members of the group, E. E. Billington, M. Christie, H. J. Hodsman, A. B. Scorer, and A. Stubbs was also recorded with regret.

The general committee had met eight times during the year, and an interim emergency committee was constituted to deal with urgent matters which might arise during the summer months. Under the convenor, the papers sub-committee had continued to do valuable work in maintaining and improving the standard of papers submitted to the group.

Eleven meetings were held during the year, eight in London and three in the provinces the latter being joint meetings held respectively with the Birmingham, Manchester and Bristol Sections.

The Group had continued to nominate representatives of the Society on various committees of the British Standards Institution and other bodies. An additional BSI Committee formed this year to formu-



Above: Mr. John Rogers, President of the SCI, talking with Mr. G. Dring and Mr. J. F. Ronca. Right: A group consisting of (from left to right) Mr. G. Ormsby Pearce, Mr. C. M. Auty, Major C. L. Patten-Bethume and Mr. Norman Fraser

late standards on Heat Insulation and Conductivity was joined by the group's nominee, Mr. Silver.

Preparation of the Chemical Engineering Section of the Society's Annual Report on the Progress of Applied Chemistry continued to be the responsibility of the group. Unfortunately, Dr. G. Edwards, who had undertaken this task for some years, had found it impossible to continue and the work had been taken over by Mr. T. K. Ross. Volume 31 of the Proceedings was published and issued during the year.

Close co-operation had been maintained with the Institution of Chemical Engineers, and it was a pleasure to record the continuance of most amicable relations with the council and officers of the Society and its editorial staff.

As in the past, the general committee wished to express its appreciation of the work of the convenors of the various subcommittees and of the loyal services given by the hon. editor, Major D. M. Wilson and by the hon. recorder, H. W. Thorp, and finally wished to register its sincere appreciation of the help given to it by Dr. Brennan, the general secretary of the Institution of Chemical Engineers during the fatal illness of Mr. C. J. T. Mackie and subsequently.

All the officers of the group were re-elected as follows: *Chairman*: H. V. Potter; *hon. secretary*, R. C. Odams; *hon. treasurer*: F. A. Greene; *hon. editor*: Major D. M. Wilson; *hon. recorder*: H. W. Thorp. Three new members elected to the general committee were: E. Le Q. Herbert, Major V. F. Gloag, and G. Nonhebel.

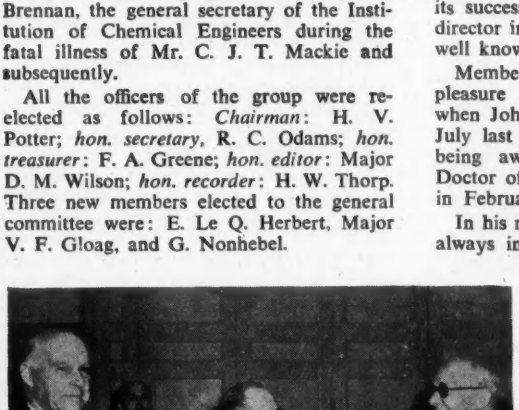
A FRIENDLY and informal gathering of some 95 members and their guests attended the annual dinner of the group held at the Hotel Rubens, London, following the annual general meeting.

Speeches, as befitted the occasion, were kept to a minimum, and in fact consisted of only two—'Our Guests' proposed by the chairman, H. V. Potter, and responded to by John Rogers, O.B.E., LL.D., president of the SCI and chairman of Imperial Chemical Industries, Ltd. Both speakers were in cheerful mood, and some humorous badinage enlivened their exchanges.

The chairman said that it was a great pleasure to have the president of the Society as their guest of honour, both because of the high esteem in which he was held personally and because he represented the largest chemical organisation in Europe. It would not be fair to reveal the date of birth of one who so ably retained the spirit of youth and energy, suffice it to say that John Rogers was a Lowland Scot, born in Glasgow, who early developed a flare for chemistry and research and all things technical. His devoted service to Nobel's and its successor I.C.I. of which he became a director in 1926, and chairman in 1951, was well known.

Members of the group would recall the pleasure felt by all members of the SCI when John Rogers was elected president in July last year and their satisfaction at his being awarded the honorary degree of Doctor of Laws, at St. Andrews University in February, 1952.

In his reply the president said that he was always in some doubt as to what to talk



In the centre is Mr. H. V. Potter, chairman of the Engineering Group of the SCI talking to Mr. S. J. Fungay

about on occasions like this, and at this gathering he was in a particular quandary as instead of proposing the toast of the group as he had anticipated, he found himself replying for the guests. On consulting their chairman for advice and information—not always the same thing—he had only been told not to start 'any funny business.'

Although looking round he realised that as a Lowland Scot he was in the minority once again he was not discouraged, but remembered the old tale of the Scotsman and the Englishman discussing their rival merits. The 'Sassenach' concluded by saying he was born an Englishman and would live and die one,' to which the Scot retorted 'Eh, mon, hae ye nae ambition?'

References to his early training reminded him of an occasion when he was working out wonderful theories in the laboratory, when an elder member of the staff after glancing at his labours exclaimed 'For goodness sake, let something occur!'

This brought him to the real value of the chemical engineer, for it was undoubtedly an important part of his rôle to help the translation from the laboratory to practical work. During his recent visit to Canada and the U.S.A. he had found a far better appreciation of the value and recognition of the chemical engineer, and he hoped that through the group, his status would soon be better appreciated in the U.K.

Finally, the chairman, H. V. Potter, spoke again for a few minutes in more serious tone. The Society, he said, like many similar organisations was at present passing through difficult times, and rising costs made it very hard to maintain its position. Accounts were unavoidably 'in the red.'

The SCI, through its groups and sections, discharged an important duty by keeping people posted in developments that were going on. It deserved to be, and must be supported by those whose interests it served.

In the group active measures were being taken to see how this situation could be rectified. The group was a platform for the dissemination of technical knowledge. Was this important task to be allowed to fail for lack of support?

An analysis of attendance at the group's lectures, taken recently, revealed that 50 per cent of those who attended were not members at all. It was up to everyone to support and join the group, or to influence

Sir Harold Tempany (right) talking to Mr. G. L. Leonard, Hon. Treasurer of the SCI. Mr. G. Dring is seen behind them

technicians and others working under them to join.

Chemical industry had given substantial sums to the Chemical Council to assist in the publication of papers of a technical nature. But was that the right way to do it? He personally was strongly against organisations such as the SCI and its groups and sections being dependent on industrial concerns—it must be done by members. He appealed to everyone to consider how far they could give their support to the group.

An expression of thanks to Dr. Brennan and his staff for organising an enjoyable evening was warmly endorsed.

Strike of Maintenance Men

Three hundred maintenance men at the works of Petrochemicals, Ltd, at Partington near Irlam, Lancs, went on strike on 3 June, as a protest against redundancy notices given to 60 employees the week before. Union officials approached the management, but they refused to withdraw the notices.

1953 Objective Passed

Britain's vast refinery extension and construction programme is well ahead of schedule and the industry's objective of a throughput of 20,000,000 tons of crude oil a year by 1953 has already been exceeded. A target of 26,500,000 tons per annum by the early part of next year is now being aimed at. British refineries are already processing approximately 23,000,000 tons of crude oil per year.

Workers' Ideas Assist Production

New Equipment & Methods Suggested Save Time & Money

THE current issue of *Target*, the monthly bulletin on productivity published by the Central Office of Information for the Information Division of The Treasury, reveals that workers at Newton Chambers & Co., Ltd., Sheffield, have submitted 5,500 ideas since the firm appointed a whole-time suggestions scheme investigator five years ago. A page and a half of pictures shows some of the suggestions which have been adopted.

Job Made Safe

Working on ladders leaning against rail tank wagons was found dangerous and a second man was needed to steady the ladder. A worker suggested that two hooked iron bars be attached to the ladder so as to grip the wagon's chassis and the job has been made safe without the need for two men to do a one-man job.

At one time tanks of acid had to be drained before the emptying points of leaking pipes could be serviced but then a worker suggested a cramp which holds the plug in position while the glands are released and repacked. An employee also suggested a metal cradle for welding 40 gallon drums. His idea was adopted and the type in use leaves both hands free and the job can be rotated in either direction by two fingers. The cradle can be tilted to any angle and castors make it fully mobile. Another idea was for an improved type of grip for lifting heavy sheets of metal by crane. The heavier the load the more tightly it is gripped.

In the same issue details are given of an improved spent oxide burner designed by Nitrogen Fertilisers, Ltd., at their Flixborough Works.

Economical dispersal of spent iron oxide —a by-product in removing sulphur from coke-oven gas in ammonia manufacture— was one problem at the Flixborough works. A secondary problem was the production of residues suitable for re-use as coke-oven gas purification material.

The firm designed a new burner which they operated as a pilot plant for about 18 months before development on a commercial scale. Fully commissioned only a few months ago, the burner is now producing 17 tons of sulphuric acid a day from the sulphur recovered from the coke-oven gas, and has already attracted the attention of other acid producers at home and abroad.

This burner can be operated so that, after the 'burning' of the sulphur, the residues discharged from the furnace can be re-used for the extraction of sulphur from the coke-oven gas.

The burner is a rotary kiln, 25 ft. long by 6 ft. 9 in. in diameter, lined with refractory bricks and fitted with a special alloy steel centre tube. The spent oxide enters the kiln at one end and, in passing through, combustion of the sulphur takes place. The residues of iron oxide are removed from the other end of the kiln by a rotary valve and conveyed to a bunker.

To ensure efficient combustion, the kiln has lifters which, as it rotates, cascade the spent oxide through the air over the full cross section of the kiln. Air for combustion enters the kiln at the same end as the spent oxide, and after passing to the end where the residues are extracted, returns along the inside of the steel centre tube. The centre tube acts both as a means of ignition for the cold spent oxide entering the kiln, and as a secondary combustion chamber. There must be complete combustion of the sulphur and carbonaceous matter in the spent oxide or troubles might arise in the sulphuric acid process later.

The burner, it is claimed, is proving very economical to operate. For maintenance it can be cooled down in 24 hours, compared with a week for the traditional type of furnace, and can be back in production again within 12 hours after repairs.

Other Internal Economies

The use of the burner makes other internal economies possible. By using the sulphur recovered from the coke-oven gas instead of selling it to other consumers, the firm expect to save over £5,000 a year. It is anticipated that another £4,000 a year will be saved by using the iron oxide residues as purifying material to recover sulphur from the coke-oven gas, and the company's consumption of imported Spanish pyrites will be reduced by 4,000 tons a year.

Coal Hydrogenation

A New Process for Production of Aromatics

DISCLOSED recently after 17 years of top secret research is a new process for the hydrogenation of coal with the specific aim of producing aromatic chemicals, and without production of gasoline, that has been developed by the Carbide and Carbon Chemicals Company of America. With a semi-works unit costing $11,000,000, the process represents a new approach to the fundamental problem of breaking down coal into usable products, and looks like putting the Carbide and Carbon Company in the van of the aromatic chemical field, a position it already occupies in the synthetic aliphatic field.

The full-scale unit for the process, when built, may cost as much as $500,000 000. It will produce, according to a report in *Chemical and Engineering News*, polycyclic and substituted polycyclic products as well as the more conventional benzene, toluene and xylene derivatives. Heavy ends will be coked to produce a product comparable to petroleum coke for use in graphite electrodes, and there will be no appreciable gasoline or aliphatic fractions.

Double Hydrogenation

All the more conventional 'synthetic fuel' hydrogenation processes hydrogenate the coal twice. Firstly to convert the coal into a heavy aromatic oil, and then again to convert the oil into lighter fractions, including gasoline. However, as the aromatic chemicals in the heavy oil are worth far more than the equivalent amount of gasoline, they are converted to, it is more profitable, if possible, to retain the aromatic oil in its original form and extract the aromatics from it. This, broadly speaking, is what the Carbide process does. All but 10 per cent of the coal, which is present in the form of free carbon, is liquified in this first hydrogenation step, and most of the resultant products are heavy, multi-ring or substituted aromatic compounds which have a high actual or potential market value.

Modern coal chemistry on which the process is based regards the coal molecule as a giant molecule in the form of a multiple hexagonal lattice. Mild hydrogenation breaks this apart into fairly large pieces. For comparison with other hydrogenation processes, the Carbide process takes up only 3-6 per cent hydrogen by weight, about half the amount of a 'synthetic fuels' producer.

The present plant in operation by Carbide and Carbon is designed to handle 300 tons of coal a day. It has not yet reached this figure, but has been running for five weeks and difficulties are being overcome. Ultimately, predict the operators, it will be able to handle 500 tons a day without basic modification. Even at 300 tons a day, it will pay its own operating expenses. However, for an optimum economic return, say the company, a commercial plant would have to process at least 3,000 tons of coal a day, a plant this size costing about $100,000,000.

Pressures Used

Pressures for the process are expected to range between 3,000 and 6,000 p.s.i.g., and temperatures from 450 to 550° C. The only other coal hydrogenation plant in the Western Hemisphere—that of the U.S. Bureau of Mines at Louisiana, operates at 10,500 p.s.i.g. and at temperatures between 800° and 900° C., understandable figures because this plant is intended to produce gasoline. However, the Bureau's liquid phase converter requires almost an hour to perform just the first step of the hydrogenation. Carbide's converter is said to perform a comparable step in about 4½ minutes.

Research on coal hydrogenation by the company began in 1935. This was about the time that the Germans first began commercial production of liquid fuels by the process. The company's interest was further stimulated by warnings from the Federal Government that supplies of natural gas—the basic material from which Carbide makes nearly all its products—were all but exhausted. The fears of the Government proved to be unfounded but the initial interest provoked in the subject persisted, and after 12 years' work on bench and pilot-plant scale, the process was ready to go into a semi-works unit. By this time the project had cost $9,000,000. With another $11,000,000 and three years' work they built the plant and started it operating. Now their foresight has been vindicated.

Chemist's Responsibility

Need for Greater Appreciation

LACK of appreciation of the work of the chemist by the general public was deplored by Mr. Henry T. F. Rhodes, chairman, in his address to the annual meeting of the London section of the British Association of Chemists held in London on 28 May.

Perhaps the reason for this, said Mr. Rhodes, was in part due to the fact that there was no organised system of propagating chemical and other scientific information to the public, but it must also be admitted that the chemists themselves were to some extent to blame as they were not always sufficiently concerned with the reaction of the community to their work.

It would be a mistake to suppose that this reaction was necessarily always sympathetic, for it was sometimes suggested that much of the chemist's work did more harm than good.

Professionally, the chemist could not, of course, control the application of the results of his work for good or evil, but this did not mean that, as a human being, he had not a responsibility to the community, which in most cases was recognised.

Return to Medieval Times

There was a real danger that on a different level science might return to that esoteric status which it had in medieval times, so that it would induce hatred and fear instead of confidence and co-operation. This would be an unmitigated disaster for civilisation.

It ought to be, and it was, one of the functions of the British Association of Chemists to publicise the facts of applied chemistry not only in their technical, but also in their ethical and social aspects. Unless this work was developed by chemists upon a national and international scale, the feeling would grow that chemical science had greater significance as a destructive than as a constructive force.

Because the BAC was numerically comparatively small it had sometimes been said that it had little influence, as if influence relied upon a mere counting of heads. In fact, it was precisely such a small and closely knit group of people which was best qualified to initiate and carry on this vital work. Much more could be done by the BAC in this field, said Mr. Rhodes.

Cock & Platinum Crucibles

IN the article 'Platinum Metals in the Chemical Laboratory' which appeared in THE CHEMICAL AGE of 26 April (pp. 645-648). the name Thomas Cock was misstated. Cock worked with malleable platinum and manufactured a number of crucibles, probably under the direction of William Allen, during the period in which he was employed by the partners Allen and Howard.

At this time crucibles were also made in this country by W. H. Wollaston; the crucibles said to be sold by Carey in 1805 were almost certainly of his manufacture, and during 1806 there was a reference in Nicholson's Journal to a crucible made by Wollaston.

The earliest known record of a platinum crucible is, however, some twenty-five years older; it was made by F. C. Achard in Germany about 1781, but it is doubtful whether an article of real utility could have been obtained by the method of manufacture described.

In 1783, letters patent were granted in Spain to Pierre-Francois Chabaneau for a process of manufacturing malleable platinum by which both ingots and crucibles were subsequently made in some quantity. At about the same period, crucibles were made in Paris by Marc Etienne Janety, perhaps at first from ingots supplied by Chabaneau, although later on a large business was built up with malleable platinum of Janety's own refining and manufacture.

Distillers' Penicillin Plant

BUILDING and equipment costing more than £750.000 which will make possible the large-scale production of new-type drugs at the penicillin factory of the Distillers Company (Biochemicals), Ltd., at Fleming Road, Speke, have reached an advanced stage and should be completed by the end of the year, it is reported. Work on enlarging the firm's plant—outgrown by recent developments—is being pressed ahead despite reduced demands for penicillin and other drugs. Because of the falling-off in demand, about 180 of the firm's 1,000 workers recently became redundant, but plans have reached an advanced stage and despite this recession in demand the company is going ahead with the present plant.

Metallurgical Section

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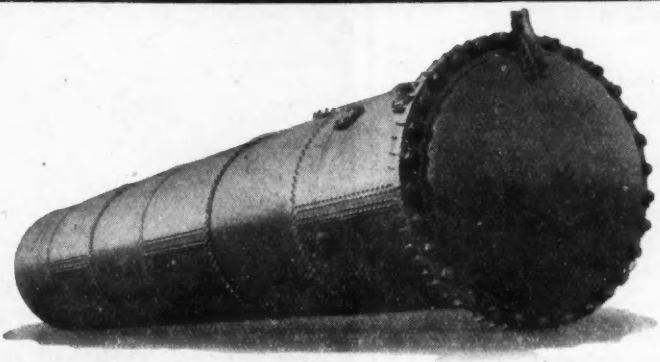

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Metallurgical Section

Orientated Crystal Deposition (Epitaxy)

Growing Scientific & Industrial Importance

BOTH from the general scientific point of view and also in many of its new technical applications the subject of orientated deposition of crystalline material (deposit or German *Gastphase*) on a crystalline substrate has become of great importance and attracted growing interest in recent years. Professor A. Neuhaus, one of the leading continental researchers in this field (of the Mineralogical Inst. TH. Darmstadt) has presented an interesting review of recent work including his own and that of co-workers (*Angew Chem.*, 1952, **64** (6), 158-162, 21 March) with a bibliography of 33 references.

The process may be simply exemplified: If a few drops of NaCl, KCl or NaBr solution are allowed to crystallise out on a freshly split surface of rock-salt under suitable test conditions, the so-called guest crystals are deposited on the substrate or carrier in a definite, orientated arrangement, for example, with edges strictly parallel to each other and to the carrier. But the two partners (deposit and substrate) need not be similar or identical, that is to say isotypes or isomorphs, but can differ widely both in composition and structure. Numerous examples are cited, such as KI on mica, hydroquinone on calcite, thiourea on zinc blende, CsCl on Ag, urea on NaCl, alizarin and many other organic partners on NaCl, Sb_2S_3, Ag, etc., as the literature references show.

Directive Forces Exercised

In all these cases the substrate surface evidently exercises directive forces on the depositing guest phase particles, due to close similarity or analogy in metrical and energy characteristics. Crystal growth takes place through such affinity in at least one surface or lattice plane. Other planes in either partner take no part in crystal growth. Partners with such partial structure relations are known as partial isomorphs or partial heteromorphs. Depositions of this kind in the solid or liquid crystalline phase in layers ranging from mono- to macro-molecular thickness on substrates of different material (*artfremden*) are known as orientated crystalline separations in the strict sense; and are to be distinguished from those in which the two partners are alike. The latter are not considered here. Experimental work and results may be divided into three periods:

Metrical Law Formulated

1. The first period, though starting with M. L. Frankenheim and his depositions of potassium halides and sodium nitrate on mica in 1835, mainly centres around 1928-30 and the research of L. Royer who formulated the metrical law of crystal growth orientation; of Barker and tolerance limits, of Sloat and Menzies also on these limits; and of Spangenberg and Neuhaus (later also H. Seifer) and others in establishing formulæ for forces involved, with a discussion of the phenomena as one- or two-dimensional special cases in crystal-chemistry affinity theory.

2. A true explanation of orientation in these depositions was to be anticipated largely through more extensive study of crystal growth with a wide range of materials under precisely controlled conditions. Much work was done in this direction. The period is roughly 1932-1940, and included among others: (*a*) Brück and Rüdiger, deposition of various metals, Ag, Cu, Au, Al, Fe, etc., by high vacuum sublimation and substrate heating, on NaCl, KCl, $CaCO_3$, mica and other minerals, with various developments in mirror technique and optics.

(*b*) G. J. Finch and co-workers (Quarrel, Wilman and others), deopsition of numerous metals by high vacuum sublimation or electrolysis. By electron interference they found that the requisite mutual adjustment between guest (deposit) and substrate (host) lattice planes was almost exclusively done by the former (*see Proc. Roy. Soc.*, A.1933, **141**,

398). The application of these investigations in explaining molecular changes or processes and the nature of the bond in soldering, welding, and galvanising soon became evident.

(*c*) A. Neuhaus studied partial isomorphic mixed systems with very widely different groups of material, including growth of inorganic molecular with inorganic ionic lattices ($CoCl_2.2H_2O$ with NH_4Cl); inorganic ionic with organic dipole lattices (K_2SO_4 with Ponceau red); organic dipole lattices of different structure with each other (phthalic acid with methyl red). In these cases separation or deposit of the guest-phase takes place preferably as a highly dispersed interchanging growth of deposit and substrate, producing a non-isomorphic mixed system in which one of the partners (guest or deposit) is quantitatively very small (less than 1 per cent).

Orientated Reaction Films

(*d*) A considerable amount of work has been done with orientated reaction skins or films on metals, especially oxidation and halide films on Cu, Al, Zn, Fe, and Ag. They are produced partly by high temperature oxidation or treatment with halogen vapour, and partly by electrolysis, and are of great interest in connection with molecular processes in corrosion and protective film formation, as, for example, in the well-known Cu/Cu_2O system and for explanations of the inhibition effect (*Sperreffekt*).

(*e*) Also much research has been undertaken in the study of orientations of organic materials mutually and with ionic, covalent and metal lattices (Neuhaud and Willems). Among examples quoted are: alizarin and anthracene derivatives having active groups —OH, $—NH_2$, Cl, Br, $—OCH_3$, $—NH.CH_3$, orientated on NaCl, KCl, $NaNO_3$, etc. In these it was possible in many cases to determine the position of individual guest molecules on the substrate surface (plane) and thus also the actual host-guest bond. This type of orientation is of great scientific and technical significance, as, for instance, in applying plastic coatings to metals, or in the inhibiting effects already noted, in abrasion and corrosion, and the brightness of galvanised films, etc. The author discusses some of the main results in this second period, with particular reference to their two-dimensional nature, the difference between azimuthal and total or partial isomorphic miscibility, mono- and multi-layer deposits, tolerance limits, and other interesting points.

The third period of development, from about 1940 to the present time, deals largely with attempts to explain the kinetics or energetics or reaction forces involved in orientated crystal deposition on a substrate, and work in this direction has been done by Volmer, Kossel, and Stranski, Rodin (Crystal-growth discussion Farad. Soc., 1949), Neuhaus and others. Among other things it was found that hardness and temperature of the substrate were important factors. Normally, orientation could take place readily on materials of hardness below 5 on Moh's scale; but for harder materials it succeeds only under special conditions, such as a sufficiently high temperature. Using the Tammann quotients T_x/T_s it is possible to determine approximately at what temperature crystal orientation can take place on hard and very hard substances. For example, to deposit an ionogenic partner on quartz, the temperature is about 830°C., on corundum 1,000°C., and on diamond 2,000° C. The conditions are more favourable if, within the silicate or other structure, there are easily reacting lattice positions, such as K, Na, Ca, or to a lesser degree also, Mn, Fe, Mg.

In a concluding note the author again surveys possible industrial applications, and these are many. A particularly interesting application is in connection with artificial rain-making, and another is in the diagnosis and treatment of silicosis. No doubt other biological or general scientific fields of interest in this will soon open up.

Tungsten in British Columbia

With the recent opening of additional plant, the Emerald Mine near Salmo, British Columbia, is now claimed to be one of the world's biggest tungsten producers. Output from the company's mine, which was the first to be reopened in Canada after the war, has been increased from 250 tons daily to between 600 and 700 tons. Two other tungsten properties are also being developed in British Columbia. One is at Hazelton, north of Prince Rupert, and is owned by Western Uranium Cobalt Mines, Ltd. The other, owned by Black Diamond Tungsten, Ltd., is near Atlin in the far northwestern corner of B.C.

Micro-Analysis in Metallurgy

A Survey of German Investigations

MICRO-ANALYSIS through the development of metallographic analysis—for closer study of constitution, growth forms and types of the various structural constituents of an alloy—has in recent years attained a leading rôle in metal research. One of the principal German pioneers in this field, Dr. W. Koch, of the Max-Planck Institute for Metal Research, Düsseldorf, in an address at Frankfurt-am-Main last year, gave a comprehensive review of progress, mainly in reference to iron and steel. His paper has just been published (*Angew. Chemie.*, 1952, **64** (7), 187-195). This study will doubtless soon extend into a wider realm and include non-ferrous metals and alloys, and also non-metals, in all of which structural forms, phase or growth changes, and crystallographic phenomena must be of increasing interest and importance.

Crystal types, non-metallic inclusions, and trace elements, all of which play a large part in the quality of an iron and steel and the tools made from them, are often more important than changes in chemical composition. This, combined with the insufficiency of chemical analysis, lends vital significance to the ultra-microscopic investigation of structural characteristics.

Study of Structure

The study of structure or texture (*Gefüge*) rests in the first place on metallographic and X-ray investigation. Even this, however, has its limitations, and it is not always possible under the microscope to identify with certainty the different phases according to their real nature. Dr. Koch cites with illustrations the case of chrome steel, and the difficulty of distinguishing carbide of the cementite kind (Fe_3C) from that of chromium (Cr_7C_3), even with the aid of an ultra-microscope of 5,000 magn. This difficulty persists with the development of other carbides in steel; and is possibly even more intractable, for example, in distinguishing oxide from sulphide or nitride inclusions.

These and other difficulties, including those of so-called local analysts, have been extensively dealt with in the literature. (*See* also F. Wever and W. Koch, *Arch. Eisenhuttenwes.*, 1950, **21**, 143-152). It is to-day mainly a matter of securing by chemical or, preferably electrochemical means, a sufficient number of the right kind of test micro samples, or isolations as they are called, of the structural constituents for study under the ultra- and electron-microscope and by X-rays. Only in exceptional cases, for example, when certain inclusions or structural constituents are present in unusual amount, are fine-mechanic methods of test-sample preparation used.

Carbides in Steel Texture

Study of carbides in steel texture, like other branches of the subject, has an extensive literature, to some of which the author refers. He briefly reviews the older treatment with non-oxidising acid and the differences shown between coarse-grained carbides and those of fine or lamellar form. Quantitative isolation of the carbide was only possible when the ferrite formed a cohesive matrix (*Grundmasse*), in the case of super-eutectoid steels. The neutral electrolyte method is now generally used. (W. Koch, *Stahl u Eisen*, 1949, **69**, 1-8).

A typical apparatus for the purpose of separating samples is shown, in which the steel test piece as anode is separated by a diaphragm from the cathode. Fresh electrolyte is fed to the anode space and, charged with iron, is led away through a Cella filter. Reference for further details is made to Klinger and Koch's *Beiträge zur metallkundlichen Analyse*, Verlag Stahleisen m.b.H. Düsseldorf, 1949.

In this anodic solution of a steel only relatively small amounts of undecomposed carbide can be separated. As solution proceeds further the surface of the steel sample is coated with carbide, thus forming a carbide electrode until a point is reached at which the carbide itself is attacked. Quantitative separation of the carbide depends directly on the development of the most sensitive micro-analytical methods. No more carbide would be taken from the steel than is needed for Debye diagram and general microscopic study. The smaller the amount of substance that can be used, the more accurate the test. Formerly 50 mg. carbide were required, involving solution of

several grams of steel; now the amount is reduced so that no more than 1 g. of steel is needed. In any case it is necessary to divide the precious sample into several separate portions, as there is no method of determining the carbon in the same separation, with the other constituents, nor, for instance, for that matter, for separating elements such as Fe, Mn, Cr, W, Mo, Si, Ni, and Ti, or S, P and N.

Chromium Steel Carbides

Some ultra-microscope diagrams are shown of chromium-steel carbides in different structural conditions, with temperatures of 600°, 650° and 735°C., magn. 18,800, showing the effect of formation temperature. It was found that even the finest carbide particles could be separated by the electrochemical method. Besides temperature the most important factor in carbide formation is time.

It is now possible to follow the kinetics of reactions in solid steel, as already described by Wever and Koch (*loc. cit.*), and of which some microphotographs are shown in the case of the γ-α-conversion of an alloy steel (0.88 per cent C, 1.05 per cent Mn, and 4.8 per cent Cr). At 1,050°C. this steel was composed mainly of γ-mixed crystals which on quenching formed martensite. If instead of water quenching the steel is rapidly coiled to below 750°C. and left for a time at constant temperature the γ-iron changes into the α-form, and the carbon, which is practically insoluble in the latter, separates out as carbide. It is important to know how the alloying element, for example, is distributed between α-iron and the carbide, how this distribution changes during heat treatment, and how after a certain time the structure of the separated carbide has altered.

Some of these changes are shown in micrographs (1,500 magn.) for a temperature of 675°C. and a two-hour period, in which is to be specially noted the change from fine lamellar carbide to that of a coarser granular form. Similar variation in separated chrome steel carbides under magn. 21,100 to 21,500 is shown, and the results graphed showing variation in Vicker's hardness (in units 0.10^{-3}) and Cr content of carbide (per cent) with increase in heating time from 0.1 to about 600 hr. (abscissae in geometrical progression), the same scale being used for both ordinates, namely, 24 to 48. After five minutes heating the carbide contains 28 per cent Cr, rapidly increasing to 38 per cent; the increase is then much more gradual, eventually reaching 47 per cent after 300 hours. This is further confirmed by Debye-Scherrer diagrams, showing the existence of the carbide Fe_3C for the first two hours, and its subsequent change to the hexagonal form Cr_7C_3 with separation also of metallic iron, as in the equation: $3(Fe, Cr)_3C \longrightarrow (Cr, Fe)_7C_3 + 2Fe$.

In solid iron the changes are naturally largely determined by the diffusion conditions of the reaction partners; and on the other hand these conditions in turn are affected by the course of the reaction. It is seen that in this γ-α conversion the chromium steel is in a metastable state for a fairly prolonged period. But after further increase of Cr content in the carbide the stable condition is achieved, together with considerable decline in hardness.

If an unetched polished steel sample is examined under the microscope certain non-metallic particles will be observed variously distributed. These are mostly oxides or sulphides, and more rarely nitrides. Their presence is due to metallurgical processing; and they are found also in other metals. At first they attracted little attention; but after Oberhoffer and others had developed methods of determining the oxygen content of steels their significance was better realised. For some time now their importance in affecting the quality of a steel has been well understood, even if there are still doubts as to the precise nature of this profound influence.

Oxide Inclusions Important

Oxide inclusions are the most important and best known. They can now be separated from most alloyed and unalloyed steels. As they are present in much smaller concentrations than the carbides, a process of preliminary enrichment is desirable. They are sometimes present in the separated carbides to an appreciable extent and must be taken into account; more often than not, however, they can be ignored. For separation of the oxides the apparatus used by Dr. Koch and co-workers is shown in the diagram opposite. It can be used also for carbides, nitrides and sulphides, by the same chlorination method, with formation of chlorides, elementary carbon, and nitrogen.

The temperature should not exceed 250°C., when the resulting chlorides—if they

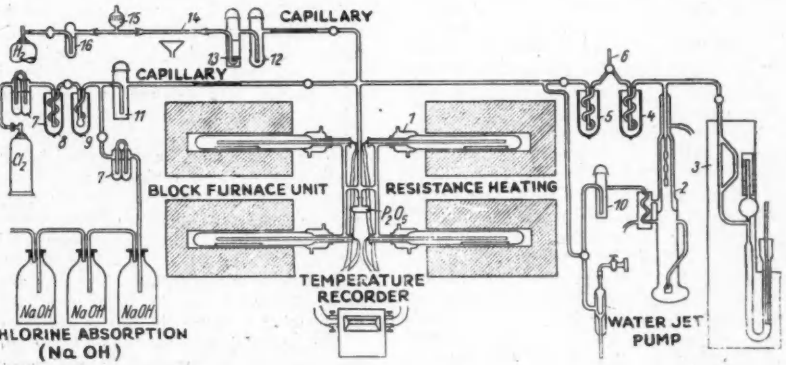
have higher sublimation temperatures—remain in admixture with the oxides, from which they must be separated after removal of chlorine under high vacuum by sublimation. Several steels may thus be tested in one operation, and only part of the complete apparatus is shown.

Since the amount of oxide inclusions in steels is much less than that of carbide it is necessary to use at least 10 g. steel in order to have sufficient material for the tests; and even so only about 0.5 to 1 mg. of oxide inclusions is obtained. According to the previous treatment of the steel these consist chiefly of wustite, silicates, corundum or spinels. After enrichment, chlorination, and vacuum sublimation, these inclusions are obtained in the form in which they were present in the steel, and only the oxide stage or valency may have changed—for example, FeO oxidised to Fe_2O_3. Some polished section micrographs are shown of the above-named forms of oxide (wustite and so on). From a study of these and of the carbides, it is possible to determine the various reactions and changes that have taken place in various metallurgical treatments.

With falling temperature the solvent power of the steel melt for oxygen declines, so that with cooling and solidifying, oxides separate out. Just before pouring, elements are added to the steel that combine more readily with the oxygen than does the molten steel, thus forming additional oxides. So far as they are not absorbed in the slag they remain suspended in the melt, and thus, also, in the solid steel, where they constitute the principal source of oxide inclusions. Steelworkers now endeavour to have these oxides in the form of freer flowing units more readily conglomerating to relatively large entities, and more easily removable from the melt. It is important therefore to have accurate knowledge of the de-oxidation reactions in liquid steel and of the structure and nature of the resulting products.

Such reactions in liquid metal differ from those in ordinary liquids by the high temperatures involved (1,500-1,600°C.), the resulting viscosity, and by the considerable differences in specific weights of the reactants. Owing to these conditions there is a tendency for the oxides to flow to the surface and leave the melt. The velocity with which an iron melt in which oxygen is dissolved combines with oxygen-seeking elements such as Cr, Mn, Si, Al, is very great, compared with the rate at which these elements, if added in the usual solid form to iron, dissolve and diffuse therein.

These first oxide particles suspended in the melt are not in equilibrium with it, since the composition of the melt is still changing so long as the added elements are not yet homogeneously distributed. Further reaction of the melt with the suspended particles



1, quartz tube with cooling slide and thermo-element; 2, high vacuum pump; 3, vacuum meter; 4, freezing out coil (safety unit); 5, freezing out coil; 6, capillary; 7, counter; 8, freezing out coil; 9, Cl liquefier; 10, drying tower with caustic soda; 11, drying tower with Mg chlorate; 12, drying tower with phosphorus pentoxide; 13, wash bottle with H_2SO_4 (1.48); 14, quartz tube with palladium-asbestos; 15, high pressure valve; 16, bubble counter with H_2SO_4 (1.84)

depends largely on their aggregation state, whether liquid, viscous, or solid, and proceeds much more slowly than in the initial stages. It may often cease before reaching equilibrium.

Silicate Inclusions

Such reactions may perhaps be better understood by reference to an example such as silicate inclusions, arising during de-oxidation of an iron melt containing at 1,500°C. 0.20 per cent dissolved oxygen. De-oxidation was affected by addition of 0.5 per cent ferrous alloy containing 48.7 per cent Si, 24 per cent Mn, and 0.44 per cent Al at 1,500°C. Two other melts were also treated: to one 0.1 per cent and to the other 0.2 per cent of the alloy was added. The inclusions of the three melts were separated, and the oxides micro-analytically and microscopically studied.

Results illustrated include the spheroidal unsaturated Fe-Mn-Cr silicates formed by addition of 0.1 per cent alloy of low m.p. and freely liquid at 1,500°C. The iron itself contains no Si, and all the Si content analytically determined (0.01 per cent) is in the inclusions. About four-fifths of the reaction products, through rapid agglomeration and surfacing before solidification, pass into the slag. Analysis in this case is 20 per cent SiO_2, 4.3 per cent Al_2O_3, 26 per cent MnO, 37 per cent FeO, and 13 per cent Cr_2O_3. In another test, with addition of 0.2 per cent alloy, it might be supposed that if only a part is dissolved, similar unsaturated Fe, Mn silicates would appear. But with further solution of alloy these have further reacted with the silicon-containing melt, and a somewhat different picture of inclusions is to be seen: the iron silicates are now covered with a more or less transparent vitreous film (*Kieselglas*) solid at 1,500°C. The amount of inclusions remaining in the solidified iron is greater than when only 0.1 per cent alloy is used, for less passes into the slag. Analysis is 58 per cent SiO_2, 2.8 per cent Al_2O_3, 25 per cent MnO, 14 per cent FeO, and 1.4 per cent Cr_2O_3. The effect of adding 0.5 per cent alloy is briefly noted, and recent work by Koch, Wenrup and Reif on deoxidation with Mn, Si, and Al reviewed (*Arch. Eisenhuttenwes*, 1951, **22**, 15-30). Reference is also made to the value of spectroscopic analysis in this connection.

Separation of nitrides, sulphides, and inter-metallic inclusions has hitherto only been possible in special cases. The electrolytic separations contain them, and their amounts can be determined, but there is no method so far of obtaining them in the pure state. (*See* paper by Kempf and Albresch, *ebenda*, **17**, 261-270). A suitable method for properly separating out the nitrides would be of particular value in metallurgy and metallography. Koch and Fink have recently (*ebenda*, **22**, 371-5) studied the possibility of enriching the sulphide content in electrolytic separations, using radioactive sulphur S^{35} in connection with the hot gases of a 50-ton Siemens-Martin furnace. But in regard to the constitution of the sulphides in steel there is still some uncertainty.

The author concludes with an expression of regret that in Germany insufficient attention hitherto has been directed to the extremely important matter of training the right type of analyst for undertaking research in these new methods of micro-analysis. It is a matter, he says, for serious consideration by the universities.

Bulk Mining of Nickel Ores

A MINING technique by which masses of ore, far underground, are induced to cave and disintegrate under their own weight, has recently been adapted at its mines in the Sudbury District by engineers of the International Nickel Company of Canada.

Called 'induced caving,' this low-cost bulk mining method, plus metallurgical practices, makes it practicable, it is claimed, to recover and treat ore lower in grade than has ever before been worked in underground mining. Thus the supply of economically available ore has been broadened, aiding Inco in maintaining its current nickel production at a post-war high level.

In caving, a 'slice' which may contain as much as 1,500,000 tons of ore, is undercut. As ore from the undercut slice is withdrawn, the slice to be mined breaks away and starts to disintegrate as it moves downward, the weight of the upper part of the mass acting to crush the ore at the bottom.

Another bulk mining technique by which the company is boosting its underground production is the 'blasthole' method. This differs from caving only insofar as explosives are used to break the slices of harder, tougher ore from the solid material. The force of gravity then takes over, as in caving.

Low Shaft Blast Furnace Research

Details of International Project in Belgium

CONSIDERABLE interest was aroused by Lord Woolton, Lord President of the Council, last November when, in welcoming the delegates to the International Symposium on the Organisation of Scientific and Industrial Research at Lancaster House, London (THE CHEMICAL AGE, **65**, 653), he referred to the low shaft blast furnace experiment as an important example of international co-operation.

Information on the jointly financed project of research using a 100-ton a day low shaft blast furnace under construction at Liège, Belgium, was presented on 20 March at a meeting of the U.S. Bureau of Mines, Pittsburgh, Pennsylvania. Details of organisation, experimental work, plant equipment being assembled, and the estimated cost of installation and operation were outlined by Dr. Louis Henry, director, of the Institut pour l'Agriculture (IERSA), of Brussels.

In an introductory speech, Mr. R. W. Tindula explained the development of the OEEC and the Committee on Scientific and Technical Matters, and set forth the policy which limited the Office of Technical Services, U.S. Department of Commerce, to arranging the meeting to acquaint private firms of the existence of the low furnace project, without in any way sponsoring it.

Blowing Thomson Steel

Dr. Henry began his talk by showing how the idea of the project had resulted from earlier experiments which used oxygen in blowing Thomas steel. Following satisfactory tests in blowing Thomas steel with a mixture of oxygen and steam, a plant with a capacity of 300 tons a day of oxygen was erected. It was then decided to continue research in other fields in which commercial oxygen might be of value.

The blast furnace project proposed to study methods of manufacture of pig iron by use of poor quality ore, fine ore, or poor quality coals. The participating countries decided to leave the OEEC to form an independent organisation, and to invite the participation of other interested parties.

It was felt that the financial backing required for installing and operating an experimental blast furnace would be beyond the means of single steel companies or of those of any European country, also the coperation of technical experts from several countries would, it was considered, bring forth more valuable new ideas. Some of the countries participating were: Belgium, Britain, France, Germany, Greece, Italy, Luxembourg, and the Netherlands. The Battelle Memorial Institute in the U.S.A. was also a member, while Brazil and other South American countries, India and Japan had also expressed an interest in the project.

Directors' Committee

The organisation consisted of a directors' committee composed of delegates from each of the participating countries. There was also a technical committee which decided on the experimental programme and the equipment necessary to carry it out. An experimental furnace was being erected adjacent to the Ugine steel plant. So far Belgian francs 35,000,000, or approximately $800,000 had been subscribed.

Besides the studying of the possibility of using low quality (minette) ores in the blast furnace employing the fine part of the ore, coke dust, low quality semi-coke, and pellets composed of fine ores and raw coal, the following fuel, air, and pressure variations would be studied in the various combinations indicated, which would require as many as 24 separate experiments.

These variables were: normal coke, fine coke, refined coke pellets, raw coal pellets, ordinary air, enriched air, pure oxygen, normal and high pressures. The furnace was being constructed so that up to 2½ kilograms per sq. cm. or 35 p.s.i. might be employed if desired.

Tentative dimensions of the furnace included an oval hearth 3 by 1½ m. or 9.8 ft. by 4.9 ft. It would have a straight cylindrical shaft 20-22 ft. high and six tuyeres would be used for combustion. It was expected that the furnace would be in operation by the end of 1952. The furnace had already been erected, but the gas-cleaning and skip equipment were only partly constructed. Plans were also being made to manufacture briquettes of coal, ore, and flux.

Location and general plans of the furnace

were decided by the following main considerations:—

(1) Construction and use of a semi-commercial manufacturing unit would be more useful than a purely experimental furnace.

(2) The larger furnace would avoid excessive heat losses that are characteristic of smaller units.

(3) The furnace would be operated to yield as many highly scientific experiments as possible, and would not be used mainly to produce a profit.

(4) Location at Liège, Belgium, had been chosen because it was near to larger blast furnaces and steel plants which could use pig iron produced, and it was also situated near to a large research laboratory.

The main technical committee was setting up sub-committees which would determine the exact technical details of the programme. The main technical committee meets once a month in Paris (France), Liège (Belgium), or Oberhausen (Germany).

(SCI) Corrosion Group

Need for Trained 'Corrosionists'

AMPLE justification for its formation is contained in the report for 1951-52 of the first official year of the Corrosion Group of the Society of Chemical Industry which held its annual general meeting in London on Wednesday, 14 May.

The Corrosion Group represents the first British attempt to provide a platform for the specific discussion of corrosion matters in the widest sense, and this report covers the period from the inaugural meeting on 17 May, 1951.

Seven meetings were held, which were well attended, perhaps the most notable being that held in London on 14 March, 1952, in conjunction with the Association Belge Pour l'Etude, l'Essai, et l'Emploi des Materiaux—section on protection from corrosion.

There was only one provincial meeting, that held in Birmingham in November. While it is inevitable that London should be the scene of most meetings, being the most convenient centre for the majority of the members, it is hoped in future that it will be possible to visit local sections. This course is obviously desirable for extending personal contacts and because corrosion is a factor in many different industries.

Membership of the group is now nearly 250, but mere numbers do not adequately convey its real strength which lies largely in its coverage of widely differing industries, while it also includes representatives from universities, research associations, and Government and Municipal undertakings. A notable feature, too, is the inclusion of overseas members from Belgium, Norway, New Zealand and the U.S.A.

An important matter to which the committee has given considerable attention is that of the training of corrosion workers and the education of engineers and others in the principles of corrosion prevention. This aspect was foreshadowed by Dr. V. R. Evans in his inaugural address, in which he emphasised the need for persons properly trained in corrosion in industry.

The name 'corrosionist' has been given, rightly or wrongly to such persons, but apart from whether it is a suitable name or not, it has the virtue of attracting attention in the outside world, and there have been articles in the technical and national Press, in which prominence has been given to the work of the Corrosion Group.

At the Birmingham College of Technology a series of educational lectures has been arranged in consultation with the group committee, the lectures being given by prominent members of the group. This course is now in progress. Another, somewhat longer, course of special lectures has been arranged at Battersea Polytechnic to start in the Autumn, the lectures being given, as at Birmingham, by visiting specialist lecturers.

Regular Feature

Evidence of the growing recognition of the importance of corrosion as an independent subject and of the work of the group in generally raising its status, is that the Annual Reports on Applied Chemistry will next year, for the first time, have as a regular feature a separate section on corrosion.

The main problem for the next session is not one of finding subjects, but rather of how to cut down the ample material into a workable syllabus while maintaining a balance between theoretical and practical interests. It is quite clear, however, that greatly increased attention will need to be given to the claims of meetings in the provinces.

Corrosion of Metals Near Wood

Chemical Factors Influencing Compatibility

WOOD and metals are used in association for so many purposes that they are justifiably regarded as highly compatible materials. Observations have shown, however, that in certain circumstance metals can be affected adversely by woods, while woods can sometimes be attacked chemically as a direct result of close association with metals. When these phenomena occur, the adverse effects on one or other of the two materials are usually regarded as inevitable or are considered to be too slight to be of economic importance. Experience gained at the Forest Products Research Laboratory over several years has revealed that there is still widespread ignorance of the extreme rapidity with which certain kinds of metallic articles can be ruined when their immediate environment is dominated by the wrong kind of wood or wood in the wrong condition.

A recently published volume of Government Research Reports includes a paper prepared by the Forest Products Research Laboratory entitled 'Chemical Factors Involved in the Utilisation of Wood in Association with Metals', by W. G. Campbell and D. F. Packman (Selected Government Research Reports, Vol. 8, 'Wood'). In this examples are given of (a) rapid corrosion of ferrous and non-ferrous metals used in association with wood, and (b) chemical disintegration of wood arising as a direct result of contact with metals.

Contact Not Necessary

Wood can affect the immediate environment of a metal even though the two materials are not in direct contact. In a confined space, such as the interior of a box, very dry wood can act as an effective desiccant because of its hygroscopic characteristics. For example, the relative humidity of the atmosphere within and around wood of 10 per cent moisture content at 25°C. is approximately 45 to 50 per cent. For most metals this is lower than the critical relative humidity at which progressive corrosion can become appreciable. It can be predicted, therefore, that no wood with a moisture content of 10 per cent or less will cause progressive wastage of metal even when the metal is embedded in it.

Research on the atmospheric corrosion of metals has shown that the primary humidity at which corrosion takes place occurs at 50 to 60 per cent relative humidity, but prolonged exposure at this humidity does not produce severe corrosion. Eighty per cent relative humidity, however, represents a secondary critical humidity at which a relatively enormous increase in corrosion occurs, especially in ferrous metals. In the air in a confined space such as the interior of a wooden box, 80 per cent relative humidity can be given at 15°C. by wood of 20 per cent moisture content, at 25°C. by wood of 18 per cent moisture content, at 40°C. by wood of 16 per cent moisture content, and at 70°C. by wood of 12 to 14 per cent moisture content.

Packing Dangers

These facts are of great importance in the packing of metallic articles in wooden boxes, especially for export to the tropics. It has been calculated that the maximum temperature likely to be attained by the air inside a wooden box exposed to tropical heat is approximately 70°C. At the Forest Products Research Laboratory it has been found experimentally that unprotected machined steel surfaces can be ruined by rusting and pitting within 48 hours, when suspended in a closed container over wood of moisture content greater than 12 per cent when the container is placed in an air-oven at 70°C.

The moisture given off by wet wood, especially freshly cut wood, is very often acidic due to the presence of carbonic, formic and acetic acids. These acids accelerate the corrosion of metals. Volatile oils such as turpentine are often present in the vapour given off by wood and may have a solvent action on some of the protective coatings applied to metallic articles.

It is believed that the acidic vapours given off by freshly cut oak and chestnut woods consist essentially of acetic and carbonic acids, which arise as a result of fermentation by yeasts and bacteria of starchy minor components of the wood. It is commonly stated that the corrosive effects of oak wood on lead can be overcome by such agencies

as charring of the wood surfaces by means of a blow-pipe flame, or treating the wood surfaces with lime, but it can be shown experimentally that neither of these treatments is completely effective. The best method of prevention consists in arresting the fermentation whereby acid is produced; for example, by thoroughly washing the wood with water. Unfortunately this treatment cannot be applied to pieces of wood of large dimensions, and from a practical standpoint it is best to start with thoroughly seasoned wood and to separate wood from lead by asphaltic bitumen of good quality, which is impervious to the acid vapours. The fundamental reason why the acid vapours from moist wood can cause progressive corrosion of lead is that acetic acid can maintain on the metallic surface a reservoir of basic lead acetate solution to which fresh lead is continually being added and from which lead is also being removed as insoluble normal and basic carbonates, through the action of carbonic acid. The process is essentially similar to the Stack process for the manufacture of white lead.

When the *p*H falls below 4.3 a relatively great increase takes place in the rate of corrosion of steel in water. Several of our common woods of commerce are capable of rendering water sufficiently acid to bring the *p*H to between 4.00 and 4.50 and a few woods have been observed to be responsible for a *p*H of less than 4.00.

Iron as Catalyst

In the process of changing from the ferrous to the ferric state iron is very active as a catalyst and is responsible for the addition of oxygen to the cellulose molecule with the formation of oxycellulose, which is brittle and mechanically weak. This explains the softening of wood around nails and bolts in structures exposed to the weather. The dark stain associated with iron in wood is due to the formation of iron tannate as a result of chemical action between iron and the wood tannins. In structures composed of wood and metals trouble is frequently experienced under moist conditions when different kinds of metal are attached to or embedded in the same piece of timber. Water in contact with wood always contains electrolytes which are derived from the wood. Therefore, when two dissimilar metals are embedded in wet wood they are liable to form the poles of a galvanic cell. Corrosion takes place in the metal which forms the anode of the cell, where metal ions enter the solution. At the same time hydroxyl ions are discharged at the cathode. The authors have observed that under these conditions the wood in the region of anodes becomes acidic and that in the region of cathodes becomes alkaline.

The vast majority of woods can, the report adds, safely be used in contact with metals, provided the woods themselves are properly seasoned and precautions are taken against high moisture contents in finished structures during service.

Metallurgy Lectures Printed

REFRESHER courses, initiated a few years ago by the Institution of Metallurgists, have proved so successful that they have now become an annual event and the recording of the lectures forms an asset to metallurgical libraries. The fourth series of lectures on 'The Principles of Extraction and Refining of Metals', given on the 1950 course at Ashorne Hill, have now been published. The course consisted of five lectures by men of high standing in the metallurgical world.

'Physical Chemistry and its Use in Extraction Operations', was the subject of the opening lecture by A. J. E. Welch, Ph.D., A.R.C.S., D.I.C., who selected for informative discussion the use of thermodynamic principles in the study of chemical reactions of metallurgical interest.

'The Place of Mineral Dressing in Extraction Metallurgy' was next dealt with by E. J. Pryor, A.R.S.M., D.I.C., M.I.M.M., who was followed by Professor C. W. Dannatt, A.R.S.M., D.I.C., M.I.M.M., F.R.I.C., F.I.M., who discussed the 'Principles of Ore Reduction'.

For the penultimate lecture L. Northcott, Ph.D., D.Sc., F.R.I.C., F.I.M., superintendent of metallurgical research, Armament Research Establishment, Woolwich, spoke on the 'Fundamentals of the Production of Metal and Alloy Ingots'. The course ended with a talk on 'Principles Underlying Refining Processes', by F. D. Richardson, Ph.D., who outlined the pattern of chemical behaviour found in some systems of major interest in refining, and how it may be further revealed by the application of basic physico-chemical principles.

Benzalkonium Chloride

Large Scale U.K. Production

IT was announced last week by Bayer Products, Ltd., that benzalkonium chloride is now being manufactured in Britain as a result of a joint enterprise with Leda Chemicals, Ltd. A new process is being employed under licence from an American Company, associated with Bayer Products, Ltd.

Benzalkonium chloride is a quaternary ammonium compound [alkyl (mainly lauryl) dimethyl benzyl ammonium chloride] with a very powerful antiseptic action and considerable wetting properties. Solutions are colourless, odourless and non-corrosive. Benzalkonium chloride has a very low toxicity, and because its action is so powerful it can be employed successfully in very high dilutions. It also possesses a very marked deodorant effect due to its high chemical reactivity.

Known in the U.S. chiefly as 'Roccal', benzalkonium chloride is replacing phenols and chlorine for many purposes. To-day U.S. production runs into several hundred tons per annum. Apart from its uses as an antiseptic in hospitals and in the home, benzalkonium chloride is included as a wetting agent, antiseptic, or preservative in many cosmetic and pharmaceutical formulations. It is employed in hairdressing salons and beauty parlours to sanitise equipment. Probably the largest use is in the catering and public house trade for sanitising dishes, drinking glasses, ice cream servers and other equipment.

Used in Food Industries

Many detergent-sanitiser combinations containing benzalkonium chloride are used in America and substantial quantities are employed in the food processing industry and breweries. The compound is effective in killing moulds and algae, and is commonly used for the control of algae in swimming pools. The fish trade employs it as deodorant and sanitiser. Large quantities are also used on dairy farms and by the dairy industry. It is becoming a common American practice to employ benzalkonium chloride in laundry work particularly for the impregnation of children's napkins.

Already many British hospitals are using 'Roccal' as an antiseptic, and the product is being sold to dairy farmers by Messrs. Gascoigne-Crowther, Ltd., of Reading, under the name 'Lactosan'.

Bayer Products, Ltd., will be pleased to hear from companies interested in the commercial development of benzalkonium chloride. Substantial tonnage is available to meet home and export inquiries.

German Microfilm on Metals

AVAILABLE now from the Technical Information and Documents Unit of the DSIR is a microfilm giving the lectures delivered at meetings of the Metals Subcommission of I.G. Farbenindustrie A.G., Ludwigshafen, between 1939 and 1944 (Reference F.D.7/52). Some reports, not of particular interest chemically, have been excluded from the summary issued by TIDU.

The subjects which are dealt with include data on European ore deposits and their exploitation in furtherance of the armament programme; technology of ore preparation and metal recovery, especially from slags, wastes and low grade ores; study of zirconium, its compounds and their utilisation; and utilisation of light metal scrap. The processes covered include: production of zinc by amalgam-electrolysis; recovery of vanadium, chromium and manganese from converter slags; production of aluminium and magnesium by various methods.

Following are the titles of a selection of the reports:

'Production of Ironstone from Scrap Iron as Raw Material for the Industrial Production of Iron Carbonyl', by Klippel; 'Production of Zirconium Light Metal Alloys by Reduction of Zirconium Chloride', by Zeppelin; 'Research on Zirconium (Production of Zirconium Light Metal Alloys—Experiments on Boron and Zirconium Alloys)', by Teichmann, Zeppelin and Lwowski; 'Comparison of the Oppau Nickel Process with the English Mond Nickel,' by Schlecht; 'Development of Corrosion-Resistant Layers on Aluminium', by Petri; 'Utilisation of Light Metal Scrap', by Schneider; 'Cementation with Zinc Amalgam and Working up of Mixed Amalgams on an Experimental Scale', by Emert; 'Experiences in the Utilisation of Vanadium Slags', by Leonhardt, and 'Recovery of Chromium and Manganese from Slags of the German Alloyed Steel Industry', by Wickman.

The Chemist's Bookshelf

ACIDS AND BASES: THEIR QUANTITATIVE BEHAVIOUR. By R. P. Bell. Methuen & Co., Ltd., London. 1952. Pp. vi + 90. 6s. 6d.

The behaviour of acids and bases is of importance in a wide variety of chemical problems. In this addition to the well-known series of Methuen monographs on chemical subjects the author, an authority in this field, has performed a valuable task in writing an authoritative and up-to-date account of the subject.

Emphasis is placed on quantitative aspects throughout the book, which begins with a discussion of the nature of acids and bases, including classical ideas and their modern extension in the Lowry-Bronsted theory. Acid-base equilibria in water are then discussed, including outlines of the determination of the strengths of acids and bases, hydrolysis, buffer solutions, the significance of *p*K values and experimental methods of investigating acid-base equilibria in aqueous solutions. This is followed by a useful survey of the behaviour of acids and bases in non-aqueous solvents and the strength of acids in such solvents. A general account of the application of the interionic attraction theory and its quantitative treatment by Debye and Huckel follows with particular application to weak electrolytes and the effects of added neutral salts.

A chapter on acid-base strength and molecular structure is particularly useful as correlation between these is often used to test theories as to the nature of chemical bonds and electronic distribution in molecules. There is a discussion of the effects of different structural factors on strength and well chosen examples of how strength and molecular structure can be related.

The book includes a chapter on acid-base catalysis and concludes with a brief discussion of alternative uses of the terms acid and base. It is perhaps a pity that a fuller discussion of the Lewis theory is not included as there appears to be some considerable use of this in American papers. However, as the author points out, emphasis has been placed on quantitative aspects and not a great deal is known of the quantitative behaviour of Lewis acids.

The references to books or review articles at the end of each chapter will be useful for further reading and the book can be confidently recommended to the honours student, the research worker and the chemist who wishes to keep abreast of modern developments in this very important field. —W. R. MOORE.

PHOTOGRAPHY IN SCIENCE AND INDUSTRY: 1952. Royal Photographic Society of Great Britain. Pp. vii + 36. 5s.

This publication constitutes the April (special) issue of Section B of the *Photographic Journal*. Previously photography in science, art and industry have been dealt with in a special number of Section A, but the more restricted field now covered makes the transfer to Section B appropriate.

A major problem facing the editor has been common to all annual reviews attempting to deal with the progress in a subject. Two courses are open, that of covering only those advances made within one year (which may in many cases be small, only integrating to major topics over several years); or that of providing review articles which give more extended attention to more limited fields. The latter solution to the problem has been accepted here, and this issue therefore contains articles as follows: Some recent developments in the theory of the photographic process: The diazotype printing process: The application of electronics in photography: Progress in colour correction by masking techniques: A year's progress in kinematography: The chemical control of processing solutions: Medical photography in 1951.

All of the reviews are authoritative and, within the limits of the space allowed to each one, adequate, although several are possibly of a more general nature than one would be led to expect by the title.—C.W.

HOME

Work Starts on H_2SO_4 Plant

Preparatory work has begun on the £4,000,000 factory to be erected by the United Sulphuric Acid Corporation, Ltd., at Tanhouse Lane, Widnes. When completed in 1954, the factory will produce 150,000 tons of sulphuric acid annually from anhydrite mined at the Long Meg mine at Penrith, which will produce 250,000 tons worth of the raw material annually.

Complaints that Stanlow Smells

Complaints about objectionable smells from oil refineries at Stanlow were made on 27 May at the meeting of Runcorn Rural Council. It was agreed that while the Council accepted the explanation of the company they were not satisfied that all precautions were being taken, and unless there was an improvement they would serve an abatement notice on the company. Mr. G. S. Wilson, one Councillor, said he knew of cases where children in the district were unable to eat their mid-day meals. In a letter to the Council it was stated that the company were expending considerable effort on the question of odour control. During the past four months a large amount of new equipment had been put into commission, but each new process had its problem.

Oil Prospecting in Lancashire

Three licences to prospect for oil in areas of Lancashire totalling more than 400 sq. miles have been granted to Steel Bros. & Co., Ltd. (registered offices 24-28 Lombard Street, London, E.C.3). The licences, announced in the London Gazette on 27 May, have been granted by the Ministry of Fuel and Power in accordance with the provisions of the Petroleum (Production) Act, 1934, and the Petroleum (Production) Regulations of 1935. A specialist team of three are already surveying the three areas, and if observations are favourable, drilling will begin in a few months.

Unions' Request to Monsanto

Monsanto Chemical Factory, Cefn Mawr, management are to be asked by the trade unions to adopt a policy of 'last in, first out' should there be further dismissals on the grounds of redundancy beyond the 75 made recently.

U.K. Glycerine Supplies

Owing to the improvement in the glycerine supply position releases for home trade manufacture were restored, as from 1 June, to the allocations prevailing prior to 1 March, 1952. A letter to this effect was forwarded to consumers of glycerine with the June allocations by the United Kingdom Glycerine Producers' Association, Ltd.

Government Loan for Fuel Saving Devices

Details of an experimental Government loan scheme to encourage the installation of industrial fuel saving equipment were announced by the Minister of Fuel in the House of Commons on 29 May. The scheme is open to industrial firms which wish to install fuel saving equipment or to insulate in order to save fuel. Devices specified are: back pressure engines and turbines; waste heat boilers; feed water economisers; air preheaters; heat exchangers; structural insulation of single sheeted factory roofs and walls. The total amount available for loans will not exceed £1,000,000 and loans to individual firms will not exceed £25,000. Commercial rates of interest will be charged.

Mechanical Handling Exhibition

Much of the equipment recommended in the reports of the productivity teams which visited the U.S.A. under the auspices of the Anglo-American Council on Productivity is to be seen at the Mechanical Handling Exhibition and Convention which began at Olympia, London, on Wednesday, 4 June. An Institute of Material Handling has been formed with a provisional council of 16 members—12 users and four manufacturers. Most of the equipment is mechanical.

Correction

On page 793 of our issue of 24 May we published a report of the symposium on chemical plant fabrication and erection held by the Institution of Chemical Engineers in which we described Mr. H. B. Fergusson as Director of the British Chemical Plant Manufacturers' Association. In fact Mr. Fergusson is a director of Messrs. G. A. Harvey & Co. (London), Ltd. The Director of BCPMA is Dr. E. H. T. Hoblyn, who took the chair during Mr. Fergusson's paper.

· OVERSEAS ·

Venezuelan and Bolivian Metal Finds

Copper has been discovered in central and western Venezuela and in other areas adjacent to the Federal District, where some workings have been started. Hitherto, exploitation of copper deposits has had no real industrial importance. Important discoveries of manganese have also been announced in the State of Bolivia.

Argentina Employs German Firm

The Sociedad Mixta Siderurgia Argentina has placed an order with a German firm, it is reported, for building a coking plant near San Nicolas on the river Parana, about 140 miles north-west of Buenos Aires, at a cost of 28,000,000 marks. It is stated that German technicians will come to Argentina to train Argentine workers and that the plant will produce 1,400 tons of coke, 72 tons of tar, 20 tons of ammonium sulphate, 17 tons of benzole and an unstated quantity of sulphuric acid daily, in addition to special oils and naphthalene.

Chilean Oil Prospects Good

In view of the excellent results of the analysis of samples taken from the oil discovered on the mainland at Punta Delgada, Chile, four other borings are to be made in the same locality, it is reported. The oil is said to be similar in quality to that previously found at Cerro Manantiales.

Exchange of Sites

A refinery site of 125 acres at Sarnia, Ontario, has been sold by the Sun Oil Co., Ltd., to Dow Chemical of Canada, Ltd., from which it has at the same time purchased a 200-acre site immediately south of its former property. The exchange was made to enable Dow to acquire property adjacent to its plant on the St. Clair river. Sun will use the newly-acquired site for a refinery announced last year.

Imported Zinc Supplies

Zinc allocations have been suspended for the rest of this quarter, and no allocations will be made for the third quarter of this year, it was announced by the International Materials Conference in Washington on 29 May. The conference feels that the supply of zinc has so improved that international allocations are no longer necessary.

Diamond Jubilee

Norway's largest cement factory, Christiania Portland, Cementfabrik, is celebrating its 60th anniversary. Since the war the factory has spent £1,500,000 on extending its capacity, and production now is about 350,000 tons a year, or almost half the total Norwegian production of cement. Although Norway is now producing about twice as much cement as before the war—720,000 tons in 1951 as against 332,000 tons in 1938 and 390,000 tons in 1939—demand still exceeds supply, and cement is one of the few commodities still rationed in Norway.

Canadian Potash Project

Information sufficient to establish the location of Canada's first potash development is expected to be obtained from the drilling of four potash exploratory boreholes which was begun at the end of last month by the Western Potash Corporation, Ltd., on its reservation holdings in the Vera-Unity area of Saskatchewan. The first borehole (WPC, No. 2) will be drilled between two sites where potash has already been found, about three miles from the town of Unity, and the underground structures are believed to be related.

Levitation is Here

Westinghouse Electric Corporation of America recently announced that they have developed a system that will float metal in space and permit it to be melted without the need for a container. The advantage of this is the elimination of the crucible and hence of any possible contamination from it. The company explains that the new procedure suspends a lump of metal by means of an electro-magnetic field while powerful electric currents reduce it to a molten mass.

To Increase Sulphur Output

United States producers of sulphur are making plans to increase their output in line with an enlarged production rate sought by the Defence Production Administration. This U.S. Government agency has set a new target of 8,400,000 tons per year by 1955 and is offering fast tax amortisation benefits as encouragement. Present expansion programmes would increase annual production to 7,150,000 tons by 1955.

PERSONAL

At the unanimous invitation of the Council, DR. G. E. FOXWELL has consented to continue to serve as president of The Institute of Fuel for a second term. During the session just completed, Dr. Foxwell as president has addressed meetings in Birmingham, Bristol, Cardiff, Derby, Glasgow, Leeds, Manchester, Newcastle and Sheffield, and taken the chair at all meetings in London.

The first award of the K.C.Li Medal for meritorious achievement in advancing the science of tungsten has been made to W. D. COOLIDGE, director of the General Electric Research Laboratory in Schenectady and X-ray consultant to the company. The gold medal, which carries with it a prize of $1,000, is made 'for conception and development of a method for obtaining ductile metallic tungsten to the benefit of all mankind'. The K.C.Li award was established by the founder, who discovered tungsten in China.

Fifty years' service with his firm was recognised in London on 26 May by presentations and a luncheon in honour of MR. L. A. DAVIES, a director of J. M. Steel & Co., Ltd. The company included Mr. C. P. Percy, chairman; Major C. J. P. Ball, vice-chairman; Mr. H. R. Peters, director; Mr. H. J. Mouland, secretary; and senior members of the staff. Also present was Mr. Kingsley Williams, director of K.W. Chemicals, Ltd., an associate of J. M. Steel & Co., Ltd. Mr. Davies, who joined the company in 1902, was made a director in 1938. He is a founder member of the Plastics Institute and a member of the Worshipful Company of Horners.

At the annual general meeting of the British Laboratory Ware Association, Ltd., held on 14 May, MR. J. S. TOWERS, of J. W. Towers & Co., Ltd., was elected chairman in succession to MR. J. E. C. BAILEY, C.B.E., of Baird & Tatlock (London), Ltd.

Other members of the council also elected were: *vice-chairman*: T. A. DRYDEN (T. Dryden, Ltd.); *treasurer*: N. MCKINNON WOOD (Griffin & Tatlock, Ltd.); *members of Council*: J. E. C. BAILEY, C.B.E. (Baird & Tatlock (London), Ltd.); F. N. BRANSON (Reynolds & Branson, Ltd.); V. J. MARTIN (Brady & Martin, Ltd.); E. C. NEWMAN (Philip Harris, Ltd.); W. H. NICHOLSON (W. B. Nicholson, Scientific Instruments, Ltd.); C. PRESTON (J. Preston, Ltd.); A. W. RANDLE (A. Gallenkamp & Co., Ltd.); N. TREPTE (W. & J. George & Becker, Ltd.); W. H. ADAMS (secretary, BLWA).

For the technical committee, MR. D. ALLAN (Townson & Mercer, Ltd.), was elected convener in the place of MR. S. J. KENNEDY (Baird & Tatlock (London), Ltd.), and members elected were: S. J. DAVIES (A. Gallenkamp & Co., Ltd.); C. A. MERRY (Griffin & Tatlock, Ltd.); A. COWLING SMITH (W. & J. George & Becker, Ltd.); S. J. KENNEDY (Baird & Tatlock (London), Ltd.).

Obituary

MR. DAVID A. PRITCHARD, of Montreal, a pioneer of the alkali industry in Canada, died in hospital on 14 May at the age of 66.

A native of Rhymney, Wales, Mr. Pritchard received his academic and technical training in England. He went to the United States in 1910 and was associated with the Pennsylvania Salt Manufacturing Company and du Pont's Philadelphia Works. In 1915, he returned to England and remained here with Imperial Chemical Industries Limited until 1922, when he went to the Canadian Salt Company, at Windsor, Ont.

In 1931 he became production manager of the heavy chemicals division of Canadian Industries Limited and in 1936 was made technical manager of the chemicals group, retiring in 1946.

The death is announced of MR. B. E. TODHUNTER, who was a director of Imperial Chemical Industries, Ltd., from its formation in 1926 until his retirement in 1944. Mr. Todhunter died on 25 May, in his 87th year. In 1900 he joined the Cotton Powder Co., Ltd., a company which was subsequently one of the constituent companies of Nobel Industries, Ltd., and he was appointed a director of Nobel Industries, Ltd., when that company was formed in 1918.

Publications & Announcements

A NEEDLE pyrometer for the accurate and rapid determination of temperatures below the surfaces of plastic or semi-plastic materials has recently been produced by the Cambridge Instrument Co., Ltd. The complete outfit comprises a sensitive thermocouple mounted inside a hollow stainless steel hypodermic needle about 1 in. long, connected by a short length of leads to an indicator, which may be of a hand pattern, or wall pattern, or portable. The needle is fitted into a convenient insulated handle, from the rear end of which extend the connecting leads, protected by a flexible steel sheath. The instrument is expected to have a wide variety of applications in the rubber, plastics, food, pharmaceutical and chemical industries.

* * *

BULLETIN No. 11 of the British Whiting Research Laboratories, of Bedford, gives an account of the annual general meeting and notes of scientific and technical meetings and lectures held during the year, including one on particle size analysis and one on dusts and powders in nature and industry. Abstracts from recent literature are also included, as well as recent additions to the library.

* * *

SELECTED values of Chemical Thermodynamic Properties by Frederick D. Rossini, Donald D. Wagman, William H. Evans, Samuel Levine and Irving Jaffe is a new publication announced by the National Bureau of Standards, U.S. Department of Commerce. Data are given on values of the heat and free energy of formation, entropy, heat capacity, and heats and temperatures of transition, fusion, and vaporisation of all inorganic compounds and organic compounds (containing not more than two carbon atoms). The circular (No. 500, buckram bound, 1268 pages $7.25, Government Printing Office, Washington, D.C.), contains all the loose-leaf tables of series 1 and 2 on this subject issued by the National Bureau of Standards from 31 March 1947 to 31 March 1950. Additional loose-leaf material, being prepared under the direction of Donald D. Wagman, will be forwarded without charge to research, educational, and industrial laboratories on request.

B.C.S.A. publication No. 4, on examples of structural steel design (Part 3) to conform with the requirements of B.S. 449: 1948, has now been published. This has been written for the British Constructional Steelwork Association by V. H. Lawton, M.I.Struct.E., and contains details of the design of stanchion bases and of a roof truss rafter composed of a single angle.

* * *

UNDER the title of 'Essential Materials for Essential Work', Bakelite Limited have produced a booklet on their range of 'Bakelite', 'Warerite' and 'Vybak' plastics. This describes the large number of applications of 'Bakelite' moulding materials, laminates, adhesives, resins, varnishes and cements, as well as of 'Warerite' and 'Vybak' plastics.

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INSTRUCTIONS for the safe handling and use of ammonium dichromate are contained in Chemical Safety Data Sheet SD-45, published by the Manufacturing Chemists' Association, Inc.

Important physical and chemical properties of ammonium dichromate are given for the information of personnel handling and using it as well as essential information about hazards to be anticipated in shipping, storage, unloading and emptying containers. A section on health hazards and their control outlines first aid measures, personal protective equipment and precautions to be observed by workers who come in contact with the chemical. Unless employees are familiar with its properties, local irritation of mucous membranes and skin are possible, and harmful effects may be produced if swallowed or inhaled. Copies of Sheet SD-45 may be ordered at 25 cents each from the Association, Woodward Building, 15th and H. Streets, Washington 5, D.C. Remittance should accompany order.

* * *

BRITISH Jeffrey-Diamond, Ltd., have recently issued a new catalogue on single roll breakers. This supersedes the company's Catalogue No. 1438C. The catalogue gives several models, their descriptions, specification, operation and application. It is available from the company at their works at Wakefield, Yorkshire.

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SITUATIONS VACANT

The engagemen of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 *inclusive, or a woman aged* 18-59 *inclusive, unless he or she, or the employment, is excepted from the provisions of the Notifications of Vacancies Order,* 1952.

ASSISTANT CHIEF CHEMIST required for Tar and Benzole Refinery near Manchester. Aged about 30-35, with University Degree or equivalent. Previous experience in the industry desirable. The post involves control, under the Chief Chemist, of the Works Laboratory. Write, stating age, qualifications, experience and salary expected, to **BOX NO. C.A. 3151, THE CHEMICAL AGE, 154, Fleet Street, London, E.C.4.**

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THE MIDLAND TAR DISTILLERS LTD. require a **CHIEF CHEMICAL ENGINEER,** the post being vacant owing to the death of Mr. Roland Scott. Only applicants of outstanding ability and wide experience will be considered. Assistance will be given in obtaining suitable living accommodation. The salary will be £1,500 per annum or over according to the ability and qualifications of the candidate. A compulsory contributory pension scheme is in operation. All replies should be addressed to the **PERSONNEL MANAGER, THE MIDLAND TAR DISTILLERS LTD., OLDBURY.**

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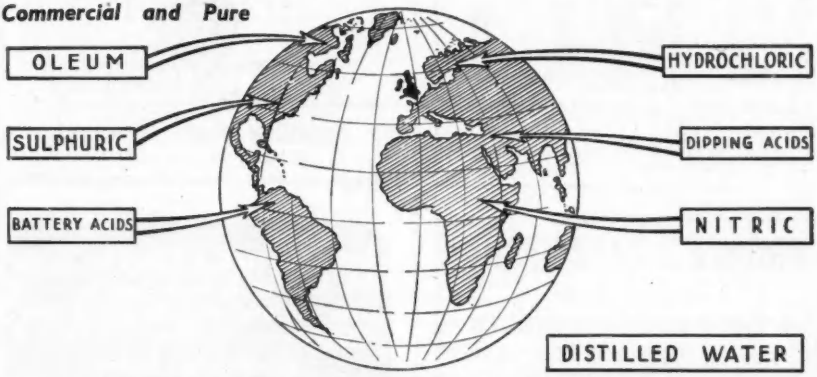

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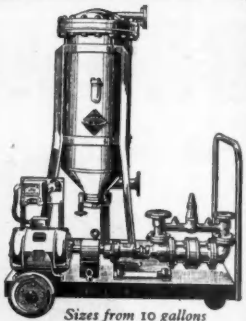
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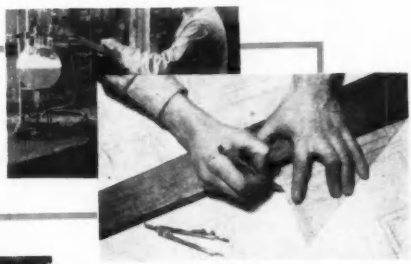

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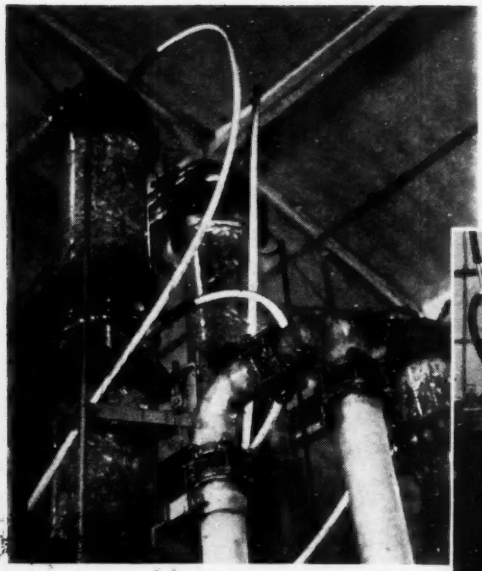
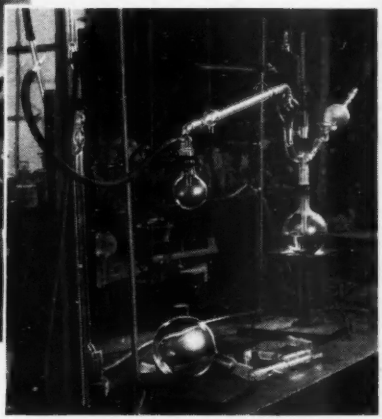


Left:
Section of Hydrochloric Acid Absorption Towers. *(Photo by courtesy of I.C.I.)*

Below:
Assembly of Utility Set for Reaction and Distillation in vacuo.



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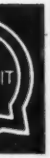

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